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THE "BOYLE"
SYSTEM OF
VENTILATION

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Registered N^o. 2285

To - *Harris Esq*
With

ROBERT BOYLE & SON'S
Compliments.

90



Handwritten musical notation in brown ink, consisting of multiple staves with notes and clefs, likely a manuscript page.

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ESTABLISHED 1832.

From *Robert Cosford,*

Builder & Contractor,

Connaught Street,
Northampton.

TELEPHONE No. 171.

C.R. Harris & Co. Ltd.

MEMORANDUM.

Jan 23rd 1890

To *Mr. Harris,*

Architect.

St. Giles' Square

Gentlemen

In reply to your letter of 22nd inst, re smoking chimney at Gds. I have made arrangement with Mr. Margate, the grocer to do the work next Monday, which day will be most convenient for him.

It will not be a very expensive job.

Yours truly
Robert Cosford

To - *Harris Esq*
With

ROBERT BOYLE & SON'S
Compliments.

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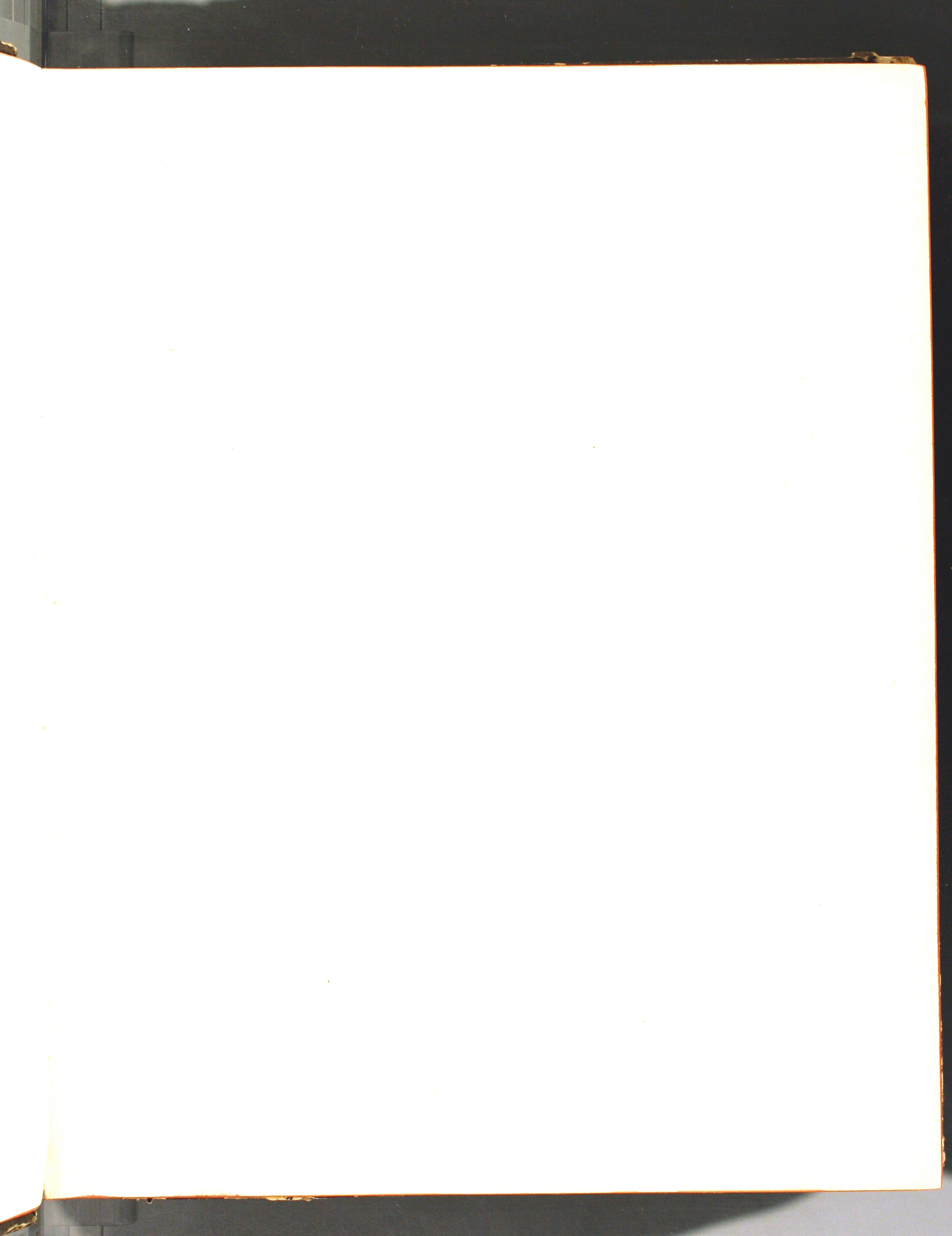
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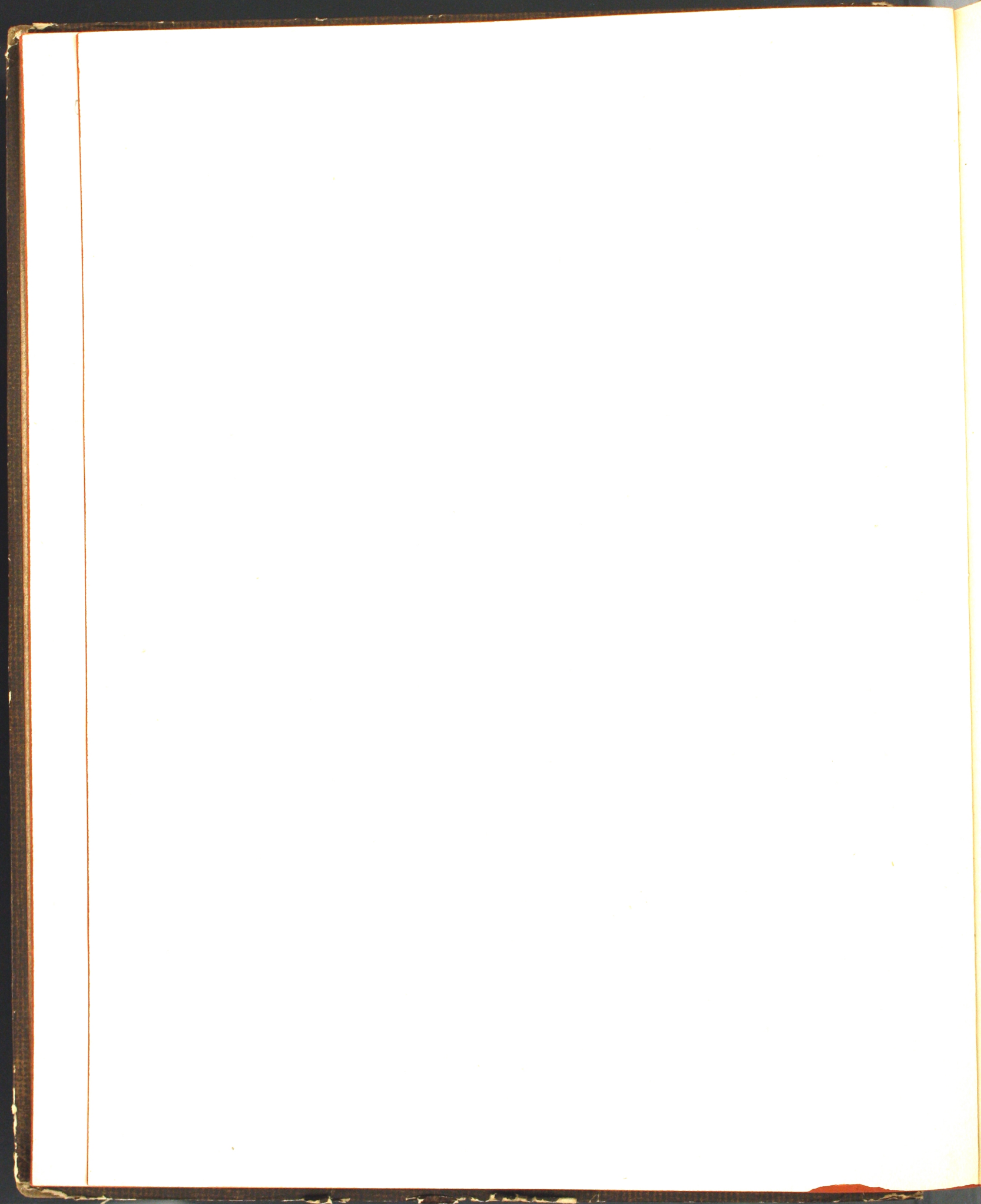
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This compilation is published not only as a business catalogue but also as a practical treatise on ventilation, and how it may be successfully achieved with the simplest means by an intelligent comprehension of the laws which govern the movements of air and the utilisation of the powerful natural forces which are unceasingly in operation. (See Supplement, page VIII, also pages 51 and 87.)

The action of both natural and artificial methods of ventilation is likewise described and illustrated by diagrams with an exposition in brief of the views held by high authorities on the subject.

R. B. & S.

DR PARKES, F.R.S.

"Incessant movement of the air is a law of Nature; we have only to allow the air in our cities and dwellings to take share in this constant change and Ventilation will go on uninterruptedly without our care. "In this country, & indeed, in most countries, even comparative quiescence of the air for more than a few hours is scarcely known.

Air is called 'still' when it is really moving 1 or $\frac{1}{2}$ miles an hour. Advantage therefore can be taken of this aspirating power of the wind to cause a movement of the air up a tube."



DR J.W. HAYWARD.

"If the inlets and outlets be properly proportioned & open, the ordinary atmospheric pressure will carry on the ventilation quite efficiently, and the whole Hospital will be kept fresh and comfortable by the natural forces alone. *u u u*

"Natural Ventilation is certainly much to be preferred to any and every artificial system whether on the plenum or vacuum principle." *u u u u*

FOR TABLE OF SIZES
AND NUMBER OF
VENTILATORS NE-
CESSARY FOR DIF-
FERENT BUILDINGS,
SEE PAGES 148-149.

9 INDEX
AT END OF
CATALOGUE

THE "BOYLE" SYSTEM
of VENTILATION has
been successfully
applied to over
100,000 BUILDINGS.



Plans and Estimates
for the Ventilation of
Buildings of every
description supplied
FREE OF CHARGE

SURVEYS AND
CONSULTATIONS
SFREE OF CHARGE

THE
BOYLE
SYSTEM OF
VENTILATION.



"A peoples' health's a nation's wealth:—FRANKLIN."

LORD KELVIN.

"I have seen several different forms of Mr Boyle's 'Air-Pump Ventilator' in actual operation, & have much pleasure in testifying to their efficiency. They thoroughly realise the favourable anticipations which I formed from experiments on models shown to me by Mr. Boyle."



SIR DOUGLAS GALTON, F.R.S.

"Boyle's Cows are arranged with fixed blades, which divert the direct action of the wind, and this causes them always to assist the exhaust; and they, moreover, afford an area of exhaust considerably larger than the area of the tube."



ROBERT BOYLE & SON, LTD.

VENTILATING ENGINEERS.



64, HOLBORN VIADUCT,
LONDON, E.C.

110, BOTHWELL STREET,
GLASGOW.

Telegrams: "Hypostile, London." Cable Code: A.B.C.
"Hypostile, Glasgow."



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SIR ARTHUR W.
BLOMFIELD, A.R.A.
Architect ARCHITECT.

"I have used the
'Air-Pump Ventilator'
of Messrs Robert Boyle
and Son with satisfactory
results. I believe the
system to be a sound
and good one, & capable
of varied application
with success." *Architect*



ARTHUR CATES, F.R.I.B.A.
ARCHITECT TO THE CROWN.

"I have used your 'Air-Pump Ventilator' with satisfactory results. Those fixed under my direction at the Library of the Inner Temple have realised my expectations and completely fulfil the object which I had in view. I consider this application of them a severe test, and the success which has attended it confirms the statements which you make as to their efficacy." *Architect*

THE "BOYLE" SYSTEM
OF
VENTILATION.

PART I.

"Pure air is the breath of life; foul air the angel of death."

SURGEON-GENERAL
SIR THOMAS CRAWFORD.

"My experience of the process of forcing air into buildings is not in its favour. The only safe and sound means for the supply of air is the natural one of obtaining it from a pure source in a free and natural flow."



W. H. PREECE · F.R.S.

"I always find theoretical men rather inclined to look with a certain amount of disdain upon practical men, and to think that practical men know nothing about their subject unless they follow the dictates of theorists. But they are now paying much more attention to the teachings of experience." 

Why we Employ A Natural System of Ventilation.

"Experiments seem to have demonstrated the perfect success of Messrs. Boyle's work."—BUILDER. (See pages 66 to 71.)

WE have occasionally been asked why, as Ventilating Engineers, we did not employ mechanical means of ventilation as well as natural. Our reply has been that, had we found that a mechanical, or any other form of artificial ventilation, answered the purpose better than a natural system, *properly applied*, we might then have adopted it; but our experience had been all the other way, and, in any case, the climate of this country was not such as would justify the great expenditure involved in the installation and maintenance of mechanical ventilation which, though seemingly most excellent in theory, in practice had not been found to realise the expectations formed with regard to it.

Our aim has been to popularise ventilation, to bring it within the reach of all, and not to make it restrictive by the employment of costly and unnecessary machinery.

It is now over fifty years since the late Mr. Robert Boyle, Sen., as a co-worker with Professor Faraday, first turned his attention to ventilation and our Mr Robert Boyle has devoted over thirty years to the practical study of the subject (we believe we were the first to exclusively practise ventilation engineering as a profession separate and distinct from anything else) and has visited the principal cities in almost every country in the world for the purpose of personally examining and testing the different methods of ventilation in use, and ascertaining how far they fulfilled the requirements of the climate, and of the buildings to which they were applied.

The data acquired in connection with these researches afford convincing proof of the superiority of a natural system of ventilation, when *properly applied*, over mechanical or other artificial systems, though, undoubtedly, where it is unskilfully, or only partially applied, failure may, and most likely would, result.

We have now in the course of our practice successfully ventilated with a natural system many thousands of public buildings in all parts of the world, in a large number of which mechanical and other methods of artificial ventilation had previously been tried, though, of course, like everything else, natural ventilation has also its limitations, and it is our opinion that no method of ventilation will ever be devised that will satisfy everyone and that will prove absolutely perfect under all conditions.

Robert Boyle & Son, Ltd.

 ALFRED
WATERHOUSE
R.A. ARCHITECT.

"I am glad to hear
good reports of your
'Cows Fixed at the
Duke of West-
minster's House'."



PROFESSOR BANISTER
FLETCHER, F.R.I.B.A.

"I have used your 'Air-
Pump' Ventilators in
several buildings and
find that they answer
their purpose well."



The "Boyle" System of Ventilation.

"The system has the great merit of being automatic."—BUILDER.

"Messrs. Boyle & Son's system is extremely simple, and may be described as the application of means by which the natural laws of ventilation can be effectively brought into operation."—BUILDING NEWS.

The "Boyle" system of ventilation is a natural one, and utilises the never-ceasing movement or natural force which exists in the atmosphere as an unfailing motive power, in conjunction with the difference in temperature of the internal and external atmosphere.

As applied to buildings, it consists of BOYLE'S PATENT Self-acting "AIR-PUMP" VENTILATOR which removes the pressure of the external air from the top of the outlet shaft and creates, under every condition of the weather, a continuous and powerful exhaust at the higher parts of the building; combined with BOYLE'S IMPROVED AIR-INLETS, fixed at the lower levels, admitting the air directly through the walls in an upward direction at a low velocity, purified, and warmed or cooled as required, ensuring a constant change of air and perfect diffusion of the fresh air-supply in strict accordance with the natural laws which govern ventilation.

The higher temperature in an occupied building—particularly in cold weather, when doors and windows are kept closed to exclude draughts—combined with the ascensional movement of the heated air arising from the lungs and body, are also scientifically utilised as powerful and never-failing auxiliaries in changing the air and inducing an inward and upward current, even when there is absolutely no perceptible movement of the air outside.

PROFESSOR MACQUORN RANKIN, after twelve months' testing, has reported: "There is no time throughout the whole year but when there is a sufficient movement in the atmosphere to cause the 'Air-Pump' Ventilator to act."

"Incessant movement of the air is a law of Nature. We have only to allow the air in our cities and dwellings to take share in this constant change, and ventilation will go on uninterruptedly without our care."—PARKES.

MR PROFESSOR
AITCHISON, R.A.

AND PRESIDENT OF
ROYAL INSTITUTE OF
BRITISH ARCHITECTS.

"When I have used
your up or downcast
Ventilators, they seem
to have answered the
purpose intended."

SIR BENJAMIN W.
RICHARDSON, F.R.S.
FIRST PRESIDENT
SANITARY INSTITUTE.

"Since these excellent Ven-
tilators [the "Boyle" Sys-
tem of Ventilation] have
been introduced we have
now got a perfect meth-
od of ventilation."

Advantages

OF THE

"Boyle" System of Ventilation.

"It is, we should say, likely to come into extensive use, and has already received the favorable notice of many distinguished experts and authorities."—BUILDER.

"As the warm air expands it ascends, . . . as the warm air ascends the air around rushes in to fill its place."—SIR DOUGLAS GALTON, F.R.S.

Dr. PARKES says: "As the ascent of respired air is rapid, on account not only of its temperature, but from the force with which it is propelled upwards, the point of discharge should be above."

With natural ventilation as applied on the "Boyle" system, the warm vitiated air is continuously drawn off, as fast as it is generated, at the highest point, to where it naturally ascends, an equivalent supply of fresh air entering at the lower levels, through specially arranged inlets.

The higher temperature in an occupied building, combined with the ascensional movement of the heated air arising from the lungs and body, are scientifically utilised as powerful and never-failing auxiliaries in changing the air and inducing an inward and upward current, even when there is absolutely no perceptible movement of the air outside.

Efficiency is secured in every season of the year, and in all conditions of the weather—in the coldest and foggiest day in winter, and the closest and warmest day in summer.

The fresh-air supply is admitted at a low velocity directly through the walls in an upward direction and is thoroughly purified, and warmed or cooled as required.

The special construction of the air inlet openings, gratings and tubes completely prevents the lodgment or accumulation of dust. They are also easily accessible for cleansing purposes. The importance of these features cannot be overrated.

The air in a building is kept perfectly clear and pure even when there is a dense fog outside. It is always in action, day and night, and can never get out of order or break down, there being no movable parts.

Requires the minimum of attention, and is under perfect control.

Can be installed at a fraction of the cost of mechanical or other artificial methods, and there is little, or no, after-expense for maintenance, according to the appliances adopted.

Extract from Report by H.M.
Chief Inspector of Factories
presented to both Houses of
Parliament, with Drawings
of the "Air-Pump Ventilator."

"Mr. Boyle's complete success
in securing the required con-
tinuous upward impulse is tes-
tified to by high authorities."



VENTILATION COMPETITION.

At the International Ventila-
tion Competition, London,
opened by H.R.H. the Duke
of Edinburgh, when all the
best known mechanical and
natural systems competed,
the "BOYLE" system (Nat-
ural) was adjudged the
best and awarded the £50
prize (only prize offered)
with Grand Diploma. ☉
Wherever it has competed
the "Boyle" system of Venti-
lation has been awarded
the First Prize 

VENTILATION.

PART II.

"Statistical enquiries prove beyond a doubt that, of the causes of death which are usually in action, impurity of the air is the most important."— Parkes.

PROFESSOR WADE.

"Ventilation can only be successfully accomplished at all times when it is effected without assistance from mechanical or artificial contrivances. However perfect these may appear, they can never achieve results superior to those ensured by judicious and intelligent adaptation of natural means; and they necessarily suffer from the very serious disadvantage that they are liable to interruption without warning, and with possibly disastrous consequences."



G.H. BIBBY, F.R.I.B.A.

"Perfect Ventilation may be obtained without liability to those dangers & difficulties to be met with where a natural system is set aside in favour of exclusively mechanical modes. The expense of mechanical ventilation is unnecessary, for there is sufficient evidence to show that such buildings as asylums, work-houses, and hospitals are best ventilated by natural means, and no architects of great repute or position have of late years relied upon mechanical ventilation." 

Ventilation.

"Ventilation is a science, and it requires the study of a lifetime to master properly all its intricacies. The greatest engineering skill is necessary in the arrangement of tubes and the supply of fresh air."—PARKES.

There is perhaps no other subject with respect to which there is greater diversity of opinion than that of ventilation. Ventilation is the most difficult of all sciences to practically deal with in such a manner as to satisfy every one. Indeed to do so is well-nigh impossible, owing to the varying idiosyncrasies and temperaments of different individuals. It will, however, be admitted that the method which secures the requisite change of air in the simplest and least objectionable manner, is the one most likely to prove generally acceptable.

That that method is the natural one when properly applied is conceded by the highest authorities on the subject. It possesses the advantage of being easily installed at a moderate cost, and, requiring no special attention, it can never get out of order or break down as so often happens with mechanical ventilation.

It is also admitted that the proper place from whence to extract the warm expired air is at the ceiling, or upper part of a building, to where it naturally ascends. Dr. Parkes, than whom there is no higher authority, says: "As the ascent of respired air is rapid, on account not only of its temperature, but from the force with which it is propelled upwards, the point of discharge should be above.

"By some it has been argued that it is better that the foul air should pass off below the level of the person, so that the products of respiration may be immediately drawn below the mouth, and be replaced by descending pure air. But the resistance to be overcome in drawing down the hot air of respiration is so great that there is a considerable waste of power, and the obstacle to the discharge is sometimes sufficient, if the extracting power be at all lessened, to reverse the movement.

"This plan in fact must be considered a mistake. The true principle is that stated long ago by D'Arcet. In the case of vapours or gases the proper place of discharge is above.

"Three forces act in natural ventilation, viz., diffusion, wind, and the difference in weight of masses of air of unequal temperature.

"In temperate climates in most cases natural ventilation is the best. Incessant movement of the air is a law of nature. We have only to allow the air in our cities and dwellings to take share in this constant change, and ventilation will go on uninterruptedly without our care."

Atmospheric air per 1,000 volumes is composed of oxygen 209.6 nitrogen 790.0, carbonic acid 0.4. Expired air contains about 5 per cent. less of oxygen, and a little more than 4 per cent. more of carbonic acid than that which is inhaled. From 25 to 40 ounces of water is passed off from the lungs and skin in twenty-four hours.

Carbonic acid gas is not in itself poisonous, but as a product of respiration, particularly in connection with an excess of moisture, its presence is always an index of contamination of the air by other impurities, such as organic matter, and it is therefore employed as the standard to determine the vitiation.

Carbonic acid diffuses in the air and does not gravitate to the lower levels.

One cubic foot of gas consumes the oxygen of about 8 cubic feet of air and produces 2 cubic feet of carbon dioxide.

The average number of respirations made by an adult is 20 per minute, 30 cubic inches of air being inhaled at each respiration, or 600 cubic inches per minute, or about 20 cubic feet per hour.

At the average temperature of 70° F. the temperature of the air as expelled from the lungs is from 85° to 95° F.

It is the organic matter suspended in the watery vapour expelled from the lungs and exhaled from the body wherein the real danger lies. As this vapour is in a heated state and immediately ascends, it should be drawn off at the highest point and not permitted to return to be rebreathed as happens with downward ventilation by propulsion, a method which has justly been described as "a standing menace to the health of society."

(Continued on page 18.)

Ventilation.

(Continued.)

"Health is only possible when to other conditions is added that of a proper supply of pure air. No one who has paid any attention to the conditions of health, and the recovery from disease, can doubt that impurity of the air marvellously affects the first, and influences and sometimes even regulates the second."—PARKES.

The old-fashioned formula which used to be employed to determine the amount of ventilation necessary for a given number of people by the height and area of a shaft or flue is now obsolete, the calculation being based upon the supposition that a column of air equal to the area and length of the shaft would always pass up and out, but it has been recognised that this is a fallacy, and that at times the air passed down as freely as it passed up, and occasionally no current either way existed at all.

With mechanical ventilation the air is propelled or drawn in at a high velocity ranging from 5 feet to 20 feet per second, destructive of diffusion, and fatal to the effective or comfortable ventilation of a building. As one authority says, "Engine-driving columns of air through a building is not ventilating it."

With downward ventilation by propulsion from three to four times the volume of air is required that is necessary with upward ventilation, the cost being proportionately increased. (See page 26.)

Extraction by fans has not been more successful, and they have in many cases to be discarded owing to the unbearable draughts they create. (See pages 24 and 25.)

Hot-air aspirating shafts are a costly and unsatisfactory method of ventilation, and are now seldom employed. (See page 54.)

Ventilation by dilution necessitates the supply of a very large volume of air to keep the air in a building in anything like a healthy state. When the ventilation is by extraction the vitiated air is removed as fast as it is generated, and healthy ventilation is secured, with but a fraction of the volume of air required for dilution by propulsion.

One of the greatest dangers to health is where the fresh air supply is raised to a temperature such as is required to effectively heat a building, as it is thereby seriously deteriorated and rendered unfit for healthy breathing purposes.

The heating of a building should always be kept separate and distinct from that of the ventilation. Radiant heat is the healthiest. (See page 28.)

The velocity of the air supply should never be greater than 2 feet per second, if draughts are to be avoided. The fresh air should be admitted at about breathing level in an upward direction through a number of small tubes distributed round the room to secure the most perfect diffusion. Where the air is warmed by passing through radiators a lower level is permissible.

If air is admitted in a horizontal direction it blows either directly upon the occupants of the room, or spreads like a fan and descends, returning the vitiated air to be re-inhaled and creating a disagreeable down-draught.

The much-maligned bacteria are sometimes employed as a "bogey" to frighten people into the adoption of certain systems of ventilation, but it is well known to pathologists that the great majority of the bacteria found in air are not only perfectly harmless but are beneficial to human beings, they acting as so many scavengers of the air, and to get entirely rid of them would be prejudicial.

How to Efficiently Ventilate a Building with a Natural System of Ventilation.

"It is essential to the success of a natural system of ventilation that both the outlet and inlet ventilators be of correct construction and skilfully applied. Where this is not observed failure generally ensues with this form of ventilation."—DE CHAUMONT.

"We have always maintained that a system of ventilation which could be universally applied must be of such a nature that it cannot get out of order, is independent of any special attention, and is self-acting in every part."—ENGINEERING.

Natural ventilation properly applied is the most constant and reliable. Once installed it requires little or no attention, is always in action, and it cannot get out of order or break down, as so often happens in mechanical ventilation.

Care should be taken in the employment of ventilators that both the outlets and inlets are sufficient in size and number, and so placed as to effectively accomplish the work they have to do.

The outlet ventilators should be fixed on the highest part of the roof, clear of all obstructions, so that the wind can reach them freely from every quarter.

The fresh-air supply should be properly proportioned to the extraction.

The combined area of the inlets should, in all ordinary cases, be at least equal to that of the outlet shafts.

Main exhaust shafts should be at least of equal area to the combined area of the branch connections.

Branch pipes should have as great an upward angle as possible, and should never enter the main shaft at the same level unless when parallel.

All pipes should be made of metal, and circular in shape to reduce friction. Wood shrinks, and is not airtight.

The vitiated air should be extracted at the ceiling, to where it naturally ascends.

The fresh air should be admitted directly through the walls at a low velocity, in an upward direction, through a number of small inlet brackets or tubes distributed round the walls to secure more complete diffusion and an equable movement of the air in all parts of the building.

Air should never be admitted in a horizontal direction as a draught would ensue.

The velocity of the air-supply should not exceed $1\frac{1}{2}$ ft. to 2 ft. per second.

The inlet channels should be as short as possible, and easy of access for the purpose of cleaning.

Long inlet channels are objectionable as they harbour dirt and are difficult of access.

Where simple inlet tubes or brackets are used, the tops should be about 5 ft. 9 in. above the floor.

Where the air-supply is warmed it may be delivered at a lower level.

The inlets should be fitted with regulating valves to control the air-supply.

The fresh-air supply should not be overheated, as its hygienic properties are thereby seriously impaired. Heating a building by hot air should, therefore, be avoided as injurious to health. (See page 28.)

Radiant heat is the healthiest and most effective.

Where open fires are used, they should have a separate air-supply, led directly to them from the outside through a 3-in. or 4-in. pipe, to prevent them drawing the hot vitiated air from above down into the breathing zone, creating draughts, and unduly affecting the ventilating arrangements.

Open Window Ventilation.

"Any method of ventilation which permits of a down-draught of cold air is injurious to health."—DE CHAUMONT.

In warm weather open windows may freely be resorted to as an aid to ventilation.

In cold weather, particularly when the heating arrangements are in operation, windows should seldom be opened in Churches, Halls, Schools, and other such buildings except when they are unoccupied. In Hospitals windows should never be opened at all in winter, on account of the dangerous down-draughts which proceed from them.

When a window is open at the top in cool weather, a stream of cold air passes into the room, spreads, and descends in a cold shower cooling and pressing down the ascending vitiated air to be rebreathed, along with the poisonous products of combustion, and the dust and dirt with which the incoming air may be charged.

It is in cold weather that special ventilating arrangements, that will change the air without draught and at the same time purify it, are absolutely necessary. In warm weather, when windows can safely be kept open—there being then not the same danger from draughts as in winter—they are not so essential so far as the air-supply is concerned.

Open Fire Ventilation.

"The air of a room may be changed by this method, but at a sacrifice of comfort, and consequent injury to health."—RICHARDSON.

Though an open fire undoubtedly acts as a powerful exhaust, it is well known to sanitarians that no more dangerous mode of changing the air in a room exists, owing to the currents of cold air set up towards it from doors and windows, causing disagreeable draughts to be experienced by those in the vicinity, or in any part of the room which the currents traverse.

The upper strata of air in the room, charged with the heated products of respiration and combustion, is drawn downwards towards the fire and inhaled by the occupants, who are thus compelled to continuously rebreathe exhausted and impure air.

All fires should have a special air-supply, led directly to them from the external air, to prevent them from causing draughts by drawing from the windows, doors, or fresh-air inlets, and counteracting the action of specially provided foul air outlets.

Where it is desired to utilise the up-draught in a chimney as an exhaust, an opening should be made into it *near the ceiling*, and fitted with a valve to prevent the ingress of smoke.

Open Pipe Ventilation.

Why it fails as an Extractor.

It is almost invariably found that where plain open pipes are used, or have merely a cap on the top to exclude rain, they are stopped up on account of the down-draught.

"Gusts of wind will sometimes cause a reverse action in the tube. In hot weather if the shaft is colder than the outer air a down current may ensue.

"In consequence of the numerous causes of disturbance enumerated above, this method of extraction, when applied to a house, could not be relied on to act on all occasions with certainty as an extraction shaft."—SIR DOUGLAS GALTON, F.R.S.

Revolving Ventilators.

"The objection to a moveable ventilator is that if by any accident it failed to turn it would become a powerful inlet."—SIR DOUGLAS GALTON, F.R.S.

Revolving ventilators soon get out of order, particularly if employed for the ventilation of drains or sewers, as the gases quickly corrode the working parts, rendering the ventilator worse than useless, owing to the down current which results in consequence of its ceasing to revolve with the required rapidity.

The pressure of the wind also in time bends the spindle out of the straight and clogs the action of the ventilator, causing it to make a disagreeable creaking noise and to become a nuisance.

Louvre Board Ventilators.

"Louvre Board Ventilators should only be employed where a down-draught is not an objection. Owing to its construction this form of ventilator is, as a general rule, inoperative as an exhaust."—VENTILATION.

Louvre Board Ventilators are of very primitive construction and were originally designed for the purpose of preventing the weather from passing into a shaft. The large body of air which it admits at the top of the shaft and which is supposed to pass across from one side to the other and thence out, simply acts as a damper upon the ascending current, and, in cold weather particularly, passes down the shaft precipitating the vitiated air and causing a disagreeable down-draught. The improved forms of ventilators which now exist, and which create a continuous up-draught and prevent down-draught, have rendered this form of ventilator practically obsolete, and it is now only used in buildings such as breweries, sheds, &c., where a down-draught is seemingly of no consequence.

Volume of Air required for Ventilation.

"As the authorities on the subject hold such widely divergent views as to the amount of air required for healthy ventilation, and there is no accepted standard, each system must of necessity be accepted on its own merits."—VENTILATION.

"With the many diverse methods of ventilation which are at present in use there can be no fixed standard in determining the volume of air necessary to secure effective ventilation; one system ensuring with a given volume a healthy atmosphere, to secure which with another system several times that volume may be required.

"At a time when the science of ventilation, and the natural laws which govern it, were but imperfectly understood, it was held by many, and still is by some, that a very large volume of air was necessary to *dilute* the vitiated air in a building to a healthy standard, from 2,000 to 6,000 cubic feet per hour per person being recommended. Experience, and a more enlightened knowledge of the subject, have, however, taught us that with the more perfect forms of ventilation by *extraction* from the upper parts of a building, to where the warm expired air naturally ascends, considerably less than the least of these estimates is sufficient for all ordinary requirements. A high authority fixes 100 cubic feet per hour per person as quite sufficient with this method of ventilation, as the average of 20 cubic feet of air which is respired by an adult per hour is expelled from the lungs at a temperature of 80 degrees to 100 degrees Fahr., and ascends, along with the heated exhalations from the body, to the upper parts of the building, and is there at once drawn off, so that no part of the vitiated air can be returned to be rebreathed, as is the case when the ventilation is effected by dilution by impulsion, particularly when on the downward principle."

As with effective upward ventilation the ascending vitiated air is drawn off as fast as it is generated, an equivalent supply of fresh air being admitted at or below breathing level, it is obvious that a considerably less volume of air would be required with this method to secure efficient ventilation than where the foul air is merely *diluted* to a given standard, as is the case with all forced systems of ventilation by impulsion, necessitating the introduction of large volumes of air.

With downward ventilation by propulsion from three to four times the volume of air is required that is necessary with upward ventilation. (See page 26.)

Velocity of the Air Supply.

"Engine-driving columns of air through a building is not ventilating it."—BUILDING NEWS.

To secure the most perfect diffusion, equable ventilation, and freedom from draught, the fresh air supply should be admitted at a *low* velocity. The highest authorities fix the maximum speed at from $1\frac{1}{2}$ feet to 2 feet per second. The air should be admitted directly through the walls into the room at a low level and in an upward direction.

The *Builder* (April 30th, 1898), referring to a mechanical system of ventilation, says:—"Mr. . . . lays it down as an axiom that the rate of air motion through the air inlets into the room should not be more than five feet per second. This is, in our opinion, and in that of good authorities, too much; and two feet per second is far preferable."

Ventilation by Propulsion.

"Engine-driving columns of air through a building is not ventilating it."

"Notorious examples of the failure of mechanical ventilation by propulsion, or artificially forcing air into a building, are the new London Law Courts and the Houses of Parliament, where mechanical arrangements are employed; and all that money and the highest scientific and engineering skill could do to make the ventilation satisfactory has been tried, but without success.

"Mechanical ventilation by propulsion forces air into a building under pressure and at a high velocity—destructive of diffusion—causing disagreeable and dangerous draughts in the vicinity, and in the line of the inlets and outlets, the other parts of the building being left wholly unventilated, as the incoming columns of air usually travel, or are propelled, in a direct line to the nearest outlet, and there make their escape. Engine-driving columns of air through a building is not ventilating it. It is a well-known fact that those employed in public buildings mechanically ventilated by propulsion constantly complain of feeling ill, and are frequently incapacitated from fulfilling their duties."—*Building News*.

"I never yet knew of a system of propulsion, pure and simple, that effected an efficient and satisfactory ventilation of any large building."—*Extract from Expert's letter published in the Builder on his Report on the Ventilation of the Houses of Parliament, 1894.*

Tables of Air Velocities and Analyses.

"Wonderful results may be shown in the way of tables of cubic feet of air propelled into a building, but they are illusory as in any way indicating the efficiency of the ventilation."—LOCAL GOVERNMENT JOURNAL.

In a recent report on the ventilation of the Houses of Parliament, it is stated that a volume of air was passed, per hour, through the House of Commons equal to ten times its cubic contents, but that in spite of elaborate tables of air analyses, the ventilation was notoriously bad and it was, therefore, clear that there was something very radically wrong with mechanical ventilation by propulsion, and that tables of volumes of air and analyses could not be accepted as demonstrating the true efficiency of the ventilation or the purity of the air.

"Tables of phenomenal air velocities and analyses are so many meaningless formulas before facts like these."—*Building News*.

Electric Fan Extraction.

"Mechanical ventilating arrangements are generally utter failures."—P. GORDON SMITH, F.R.I.B.A., *Architect to the Local Government Board.*

"According to the *Bristol Mercury*, there are serious complaints amongst the Councillors about draughts in the Council Chamber. The excessive draught in the Chamber has led to inquiries, which have resulted in the explanation that the special electrical ventilation apparatus has never had a real chance of justice being done to it. This arrives, the *Mercury* states, 'from the fact that it is so scientifically arranged and adjusted for precise conditions, that the moment these conditions are broken the delicate arrangement of the apparatus is dislocated and its effect entirely lost. It is stated that it was designed for a room with closed doors, and the ordinary ventilators in the walls of the hall intended to admit fresh air should be left open. But the practice is for all these ventilators to be closed, as the room is felt to be too cold, and then only too often the doors at the extreme end are thrown open. Immediately these conditions prevail the whole effect of the Electric Ventilator is subverted, with the result that an insufferable draught is generated.'"—*Builder* (May 14, 1898).

"Apparently mechanical ventilation is not appreciated by the members of the Bristol City Council where, according to the *Western Daily Press* :—'Mr. Abbot complained that they were being stifled, the ventilating fan not being in operation. The Mayor gave instructions for the matter to be seen to. Ald. Davies now asked leave to move the adjournment of the house until Tuesday next to the Guildhall. Really that Council Room was unbearable. Mr. Levy-Langfield begged to second that. Some confusion resulted. Complaints of the draughts were made by many members, and Mr. Pembery asked : Do you object, Mr. Mayor, to our wearing our hats? The Mayor: Order, order. Members sitting on that side of the room then closed the ventilators from which the cold air was descending. Mr. Pembery: Will you, Mr. Mayor, give instructions to stop the ventilating machine. I would rather stifle than be killed in this way. The draught is terrible. The Mayor: If you will kindly take your seat I will have the matter attended to. It was then understood that the ventilating fan was put at half speed and business was resumed.' If the choice is really between stifling and 'draughts,' the ventilation of the Bristol Council Chamber is a problem still unsolved."—*Building News* (February 11, 1898).

Electric Fan Extraction.

(continued.)

" Ideas regarding the best method to secure ventilation having undergone considerable change within recent years, mechanical arrangements giving place to simpler and more effectual methods."—BUILDING NEWS.

" Under the heading of 'Ventilation,' a correspondence has appeared in the *Manchester City News* relative to the discomforts of electric fan ventilation. The following extract is suggestive, and would seem to confirm the complaints which have reached us from time to time with respect to that method of ventilation: 'The mephitic atmosphere of Public Rooms, Committee Rooms, Club Houses, Lecture Halls, Churches, and the like has long been a source of disease. The application of the electric fan has up to now done little more than substitute a thorough draught, the which of all discomforts an Englishman will least tolerate. In the circulars of ventilating engineers you find the statement that their particular fan will renew the air of a room so many times, say six times, per hour. This statement is not true. What is true is that sufficient air is extracted whose volume would fill the room six times per hour, and that, of course, an equal quantity of air is sucked into the room; but to infer that all the vitiated air, or half, or a third of it had been disturbed and drawn off is to come to a false conclusion. I could take you to a large smoke room in town where a fan is at work on one side of the room where it is so draughty no one will sit. At the other side of the room it is suffocatingly hot, with no apparent movement of air. And this ineffective device cost £200 to put in. The main fault consists in localising the extraction. My conclusions, I may add, are based on the study of hundreds of cases.'"—*Building News* (August 12, 1898).

"After several tests in schools ventilated on each system, it was clearly demonstrated that in none of the schools examined and ventilated mechanically by extraction—even in a new school opened for a week or two—was the air found to be more pure than in those examined and ventilated naturally without any mechanism. Draughts existed in the upper levels of every room ventilated mechanically by extraction while the halls of such buildings were generally full of draughts."—*Extract from a paper on "Ventilation," read before the Society of Arts, London.*

Downward Ventilation by Propulsion.

"It goes without saying that fresh air passing through a stratum in which gas lights are burning cannot avoid bringing the carbon oxides, acetylene, and other products of combustion into the respiratory atmosphere. For English practice, therefore, it may be regarded as incontrovertible that, save in a few exceptional instances, an upward current of the fresh air is preferable."—BUILDER (September 5, 1896).

*Extract from Report laid before the United States Congress by the
Commission on Ventilation:—*

"The relative merits of the upward *versus* the downward systems of ventilation may be estimated from the following considerations:—

"1. The direction of the currents of air from the human body is, under ordinary conditions, upwards, owing to the heat of the body. This current is an assistance to upward, and an obstacle to downward, ventilation.

"2. The heat from all gas-flames used for lighting tends to assist upward ventilation, but elaborate arrangements must be made to prevent contamination of the air by the lights if the downward method be adopted.

"3. In large rooms an enormous quantity of air must be introduced in the downward method if the occupants are to breathe pure fresh air, or about three times the amount which is found to give satisfactory results with the upward method.

"4. In halls arranged with galleries, the difficulty of so arranging downward currents that, on the one hand, the air rendered impure in the galleries shall not contaminate that which is descending to supply the main floor below, and, on the other hand, the supply for the floor shall not be drawn aside to the galleries, is so great that it is almost an impossibility to effect it.

"Perfect ventilation would not be obtained, for this would only provide for the *dilution* of the impure air, while in perfect ventilation the impurities are not so diluted, but completely removed as fast as formed, so that no man can inspire any air which has shortly before been in his own lungs or in those of his neighbour.

"For these and other reasons the Board are of opinion that the upward method should be preferred."

Downward Ventilation by Propulsion.

(continued.)

"No amount of air forced on this plan into a building could make the ventilation either efficient or safe."

Extract from Report on the Ventilation of the Chamber of Deputies, Paris, by M. Emil Trélat :—

"The fresh air is delivered at the top of the room, and the currents of air are strong and varied, causing great discomfort.

"The air is delivered by fan propulsion at the ceiling, and is taken out at the floor, giving a downward system of ventilation.

"The apparatus is powerful enough to change the air in the chamber every six minutes ; but it can only be worked slowly, owing to the draughts produced, and the air vitiated by respiration is brought back to be reinhaled."

The Builder (April 30th, 1898), on the fallacy of Downward Ventilation by Propulsion :—

"With all down-draught systems diluted foul air only is breathed."

"There are also some statements and theories to which we take exception. One of these is the argument that because carbonic acid gas is 52 per cent. heavier than air, it is, therefore, desirable to ventilate by a downward current in a room rather than an upward one. The fallacy of this will be obvious to every one of our readers who smokes, if he will notice the course of the smoke after being exhaled. It is almost impossible in an ordinary room to make the smoke go down to the floor without a very violent effort. In all ordinary expulsion it would be noticed that the smoke ascends, and quickly becomes disseminated through the air of the room. The scientific fact is that air exhaled from the lungs is, at the moment of exhalation, equal in weight to pure air at a temperature of 90 deg. Fahr. And until the exhaled air has parted with so much of its heat as to become heavier than pure air at this temperature, it will rise in a normally pure atmosphere."

Hot-Air Supply.

Inimical to Health.

"The hygienic drawbacks of hot-air heating are recognised."—BUILDER.

"The fresh air supply if heated to such a temperature as is necessary to effectually warm a building, is thereby seriously deteriorated for breathing purposes, therefore, to secure healthy ventilation, the heating of a building should always be separate and distinct from that of the air supply."—VENTILATION.

"The latest evidence submitted at the Royal Institute of British Architects and at the International Congress of Hygiene, Budapest, has conclusively demonstrated that heated air employed for the double purpose of ventilation and warming is not only unhealthy, but fails as an efficient heating medium.

"Sir DOUGLAS GALTON, in a paper read at the Congress, strongly condemned this mode of heating and ventilating a building, stating that: 'The method of warming the walls by means of heated air necessarily leaves the walls colder than the air of the room, and the heat of the body is radiated to the colder walls. Hence, if the walls are to be warmed by the air admitted to the room, the temperature of the warmed air must be raised beyond what is either comfortable or healthy for breathing, and thus, if you obtain your heat by warmed air alone admitted direct to the room, discomfort in one form or the other can with difficulty be avoided.'

"Professor CORFIELD (Professor of Hygiene and Public Health, London University) said: 'Heating should be done by means of radiant heat, and not by means of air previously warmed. If air was previously warmed it would lose a portion of its oxygen, and if we got air short of oxygen we had to breathe a greater number of times to supply the required amount, and that meant more effort.'

"M. EMIL TRÉLAT, who is recognised as the highest authority on the subject in France, said: 'The solution of the problem of heating dwellings has absolutely no connection with that of their ventilation.'

"Mr. THOMAS BLASHILL (Architect to the London County Council) and others present at the Congress expressed themselves in similar terms with regard to the unhealthiness of breathing warmed air which was employed for the purposes of heating."

Testing Ventilation.

"Reports of ventilation tests are misleading unless the exact details of the systems tested are given, and the conditions under which each has been applied and tested are clearly stated, as one system may have been applied and tested under the most favourable conditions, whilst another may have been incompletely applied and tested under unfavourable conditions. Where these particulars are not given all such tests must be considered as valueless as a means of comparison."—VENTILATION.

"It is a curious fact, and one that should be carefully noted, that not one single instance is given of the mechanical system having been tested against any automatic system, the Schools mechanically ventilated being tested against Schools having *only the windows and doors to rely upon for ventilation*—that is to say, Schools in which *no system of ventilation existed at all*. It would have been interesting to have known what the results would have been had a good automatic system been in use, applied under equally skilled advice as the mechanical. They (the experiments) are, for all scientific or practical purposes, valueless, as they prove no more than that an elaborate and costly system of mechanical ventilation has been found in a few special instances to be slightly more effective than where there was *no system of ventilation in use at all*."—BUILDING NEWS.

Testing Ventilators.

"There is only one trustworthy way of proving the efficiency of any ventilating arrangements, and that is by actual and extended practical experience. Lecture-room experiments, as all privately-conducted experiments can only be called, may be all very well in theory, and show certain results, but in actual practice the results are generally found to be very different."—ARCHITECT

Experiments have been instituted from time to time for the purpose of ascertaining, if possible, the exact relative values of exhaust ventilators, by testing them on specially arranged pipes.

The results of these tests were found, however, to be so conflicting that it is now considered by sanitarians that experiments of this kind are valueless as a means of determining which is the most efficient ventilator under all conditions.

The "Kew experiments," inaugurated by the Sanitary Institute, may be cited as a well-known example.

The *Times*, which was selected by the Institute to report the tests, said: "The method of testing was incorrect, and therefore the tests are valueless. Neither in the case of the cowls nor the tubes was their true value as extractors ascertained."

This method of testing has also been discredited by so-called experiments carried out by certain ventilator makers and patentees of rival systems, when it was found in the case of each that the results were exactly reversed.

There is only one reliable way of testing ventilators, and that is when they are in practical use.

Their efficiency can only be determined when they have been tried for a lengthened period, in every season of the year, and under all conditions of the weather and of the buildings to which they may be applied.

Instruments for Testing Ventilation.

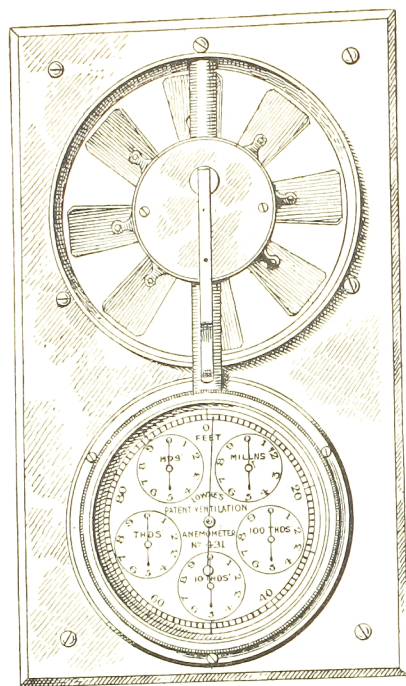


Fig. 1.

Anemometer.

For registering the velocity of air-currents.

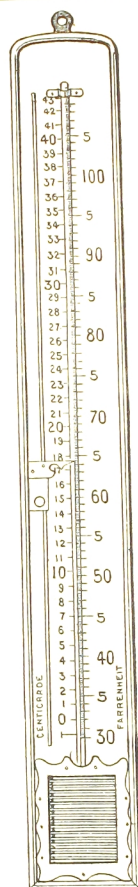


Fig. 2.

Highly Sensitive Gridiron Bulb Thermometer.

Fitted with sliding index for observing difference of temperature between any two localities, or in any given interval of time.

Can be read to 1-10th of a degree by direct observation.

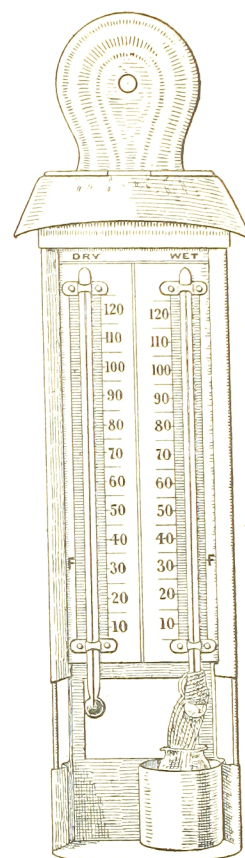


Fig. 3.

Hygrometer.

For registering the humidity of the air.

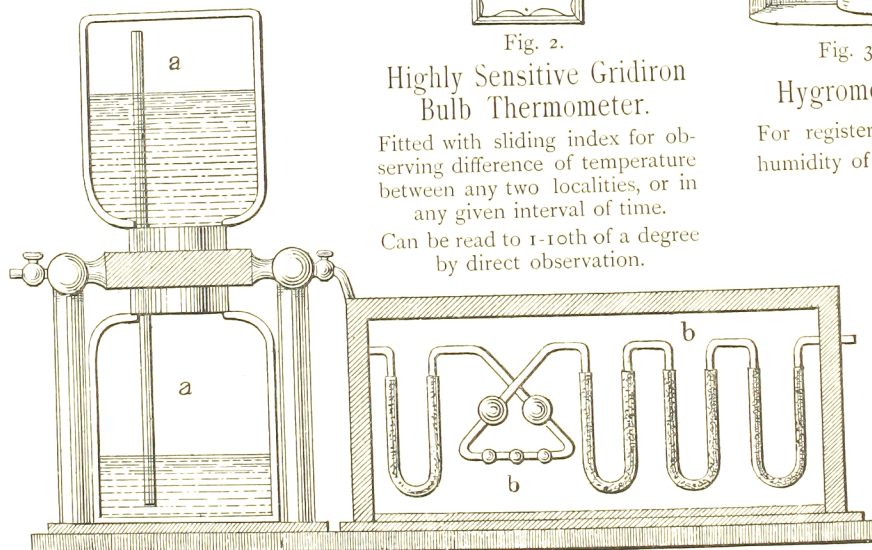


Fig. 4.

Carbonacidometer.

For testing the proportion of carbonic acid contained in the air.

Air Analysis.

In buildings, such as Hospitals and Asylums, an analysis of the air might be made periodically, as the Medical Superintendent would, in most cases, be qualified to judge if the tests were correctly made; if he did not make them himself. In other buildings, such as Churches, Halls, Schools, Workrooms, &c., there would be some difficulty in securing reliable analysis, there being so many conditions under which tests may be made that might render them misleading, and valueless as indicating the general purity of the air.

It is notorious that, in spite of elaborate tables of analysis of the air of many public buildings in which the most complete forms of artificial ventilation are in use, the condition of the air in these buildings is not found by those occupying them to be in accord with the analysis, so far as their sensations are concerned.

In a recent report on the ventilation of the Houses of Parliament the following passage occurs: "When one considers the enormous volume of air, equal to ten times the cubic contents of the House of Commons, which is passed through it every hour, also that the elaborate tables of air analysis are apparently all that could be desired, and yet the ventilation is so notoriously bad, it is clear that there is something very radically wrong with mechanical ventilation by impulsion, and that tables of analysis and of volumes of air passed through a building are not to be accepted as correctly indicating either the general purity of the air, or the efficiency of the ventilation."

Analysis of the air is a very good thing so far as it goes, but it may, with some justice, be objected that it does not go far enough, for all the tables of analysis in the world will not convince people that the air of a building is pure if they, from their own actual experience and the unerring test of their senses, are satisfied that it is not so.

After all, the feelings of the occupants are the surest index of the state of the air in a building and should in most cases be accepted as conclusive, irrespective of air analysis which, however desirable, is not always to be relied upon.

If the air but smells fresh and sweet, and there is an absence of that feeling of *malaise* and discomfort usually experienced in a badly-ventilated building, most people are content to look upon air analysis as a negligible quantity, though they may not always be correct in doing so.

SIR JOHN MONCKTON,
TOWN CLERK, LONDON. &

"I am asked by Messrs Boyle and Son to state my personal experience of the recent Ventilation of the Council Chamber. I can do so in a very few words. Until the present year I never knew what it was to leave the Guildhall on a 'Common-Council day' without a headache. I now do not know what a headache is. In fact the palpable alteration for the better in the atmosphere, even on crowded days, is very satisfactory, and it appears to me, a non expert, that Messrs. Boyle's system is eminently valuable and practicable."

REV. NEWMAN HALL,
CHRIST CHURCH, LAMBETH.
(ROWLAND HILL MEMORIAL CHURCH)

"I consider our ventilation
very successful."



THE "BOYLE" SYSTEM
OF
VENTILATION
AS
APPLIED TO BUILDINGS.

PART III.

"Messrs Robert Boyle and Son as founders of the profession of Ventilation Engineering have raised the subject to the dignity of a science."—
Report on the Ventilation of the London Custom House.

T. J. BAILEY, F.R.I.B.A.
ARCHITECT TO THE
SCHOOL BOARDS OF LONDON.

"So far as I have used
your Air-Pump Ventilators I am satisfied with
their extracting power-
provided a sufficiency of
fresh air is brought into
the room in proper position.

I have adopted them in
buildings in lieu of the
Ventilating ridge which I
used formerly as the latter
allows so much downdraught
and inlet of 'blacks'
in London?"



JOHN OLDRID
SCOTT, Architect.

"I have much pleasure
in testifying to the success
of the Ventilator you fitted
up for me in St. Margaret's Church,
Brighton. I am assured
that medical men recommend
their patients to
attend this Church because
of the purity of
its atmosphere." *etc.*



Ventilation of Churches.

"Pure air ensures health and happiness; foul air disease and death."—PARKES.

The vitiated atmosphere usually found in imperfectly ventilated churches is the principal cause of the drowsiness with which many of the congregation are overcome before the service is over, and the fainting fits which so frequently occur in certain churches. This is due to a deficiency of oxygen in the air and an excess of carbonic acid gas, watery vapour, and foetid organic matter, combined, when the gas is lighted, with the poisonous products of combustion. A feeling of oppressive closeness and heat is also generally experienced under such conditions.

To the deleterious quality of the air found in so many churches is to be ascribed what is known as "clergyman's headache," and the feeling of lassitude and nervous irritation so commonly experienced during and after the services.

Badly ventilated churches and halls are, more than any other cause, responsible for the dissemination of disease, and many people abstain from attending on that account alone who would be only too glad to be present if the air was but in a healthy state.

All this might be avoided if proper means were employed to remove the vitiated air as fast as it was generated, and to provide a sufficient supply of fresh pure air to take its place. This is now neither a difficult nor an expensive matter with the improved appliances which are in existence, and which utilise the natural forces ready to our hand to be our good servant if but properly managed. There is not the slightest necessity to resort to costly mechanical arrangements.

The immutable and beneficent laws of nature, if but properly understood and intelligently adapted, will do all that is required—silently, continuously and effectively.

The vitiated air should be extracted at the highest part of the church, to where it naturally ascends, and the fresh air admitted at or below the breathing level in an upward direction and at a low velocity through brackets or tubes distributed round the walls to secure more perfect diffusion and an equable distribution and movement of the air throughout the church.

Where simple openings are made in the ceiling or the roof, and the air is admitted at the upper parts of the windows through glass hoppers, downward currents of cold air invariably result, which press down and return the ascending expired air, to be rebreathed along with the products of combustion and other impurities.

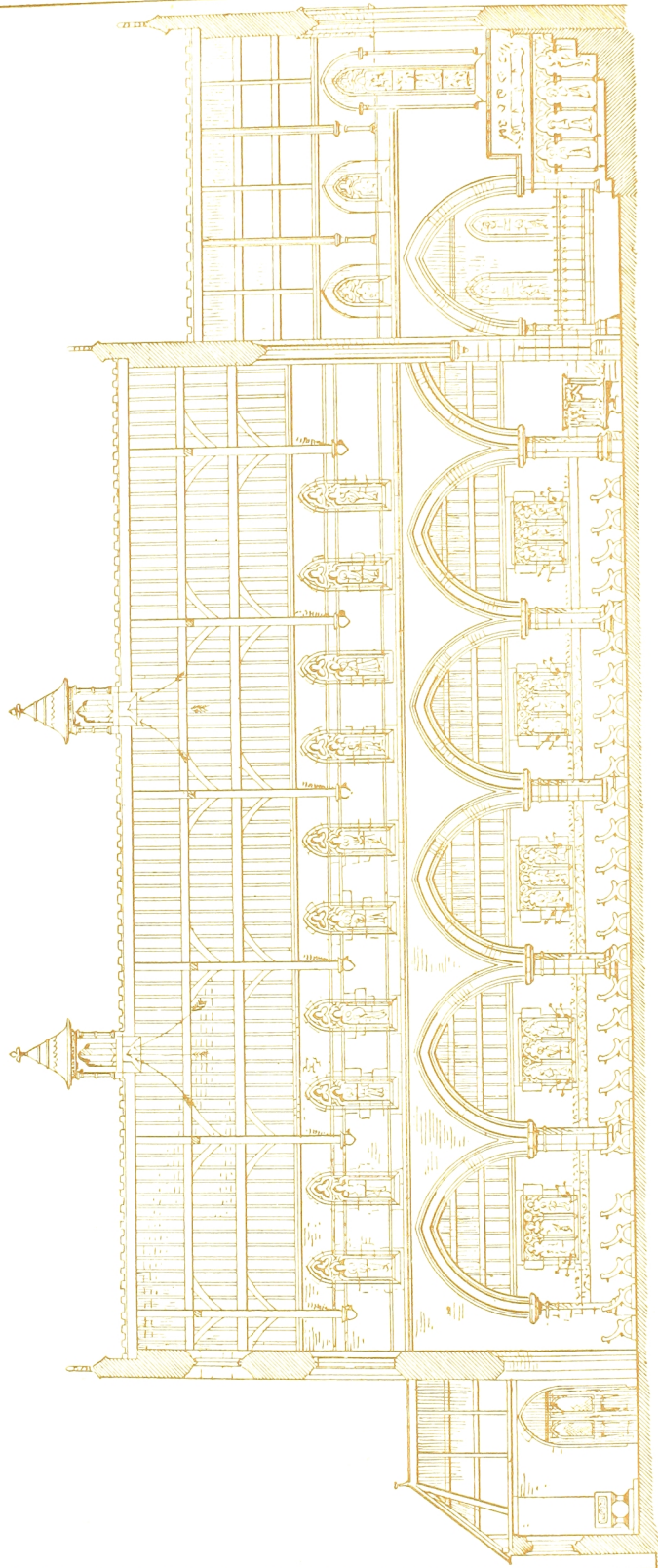
In cold weather, downward currents of air may arise from the condensation of the warm air on the windows, walls, or open roof. This might to a great extent be overcome by thickly felting and double boarding the roof, having the walls thoroughly warmed by means of radiant heat and the windows double glazed, or a radiator, or hot water or steam pipes placed underneath them to cause a counter and upward current of heated air. Where extraction ventilators are employed they are sometimes blamed for the down-draughts which arise from these causes.

Hot air should never be employed to heat a church as it is injurious to health owing to the high temperature required for effective heating, and which destroys and deteriorates a part of the oxygen required for the proper maintenance of health. Breathing warm air also enervates and lowers the tone of the system, rendering it more susceptible to disease. (See page 28.)

THE "BOYLE" SYSTEM OF VENTILATION

As applied to ST JOHN'S CH., ST LEONARDS ON SEA.

under the direction of SIR ARTHUR BLOMFIELD, BART



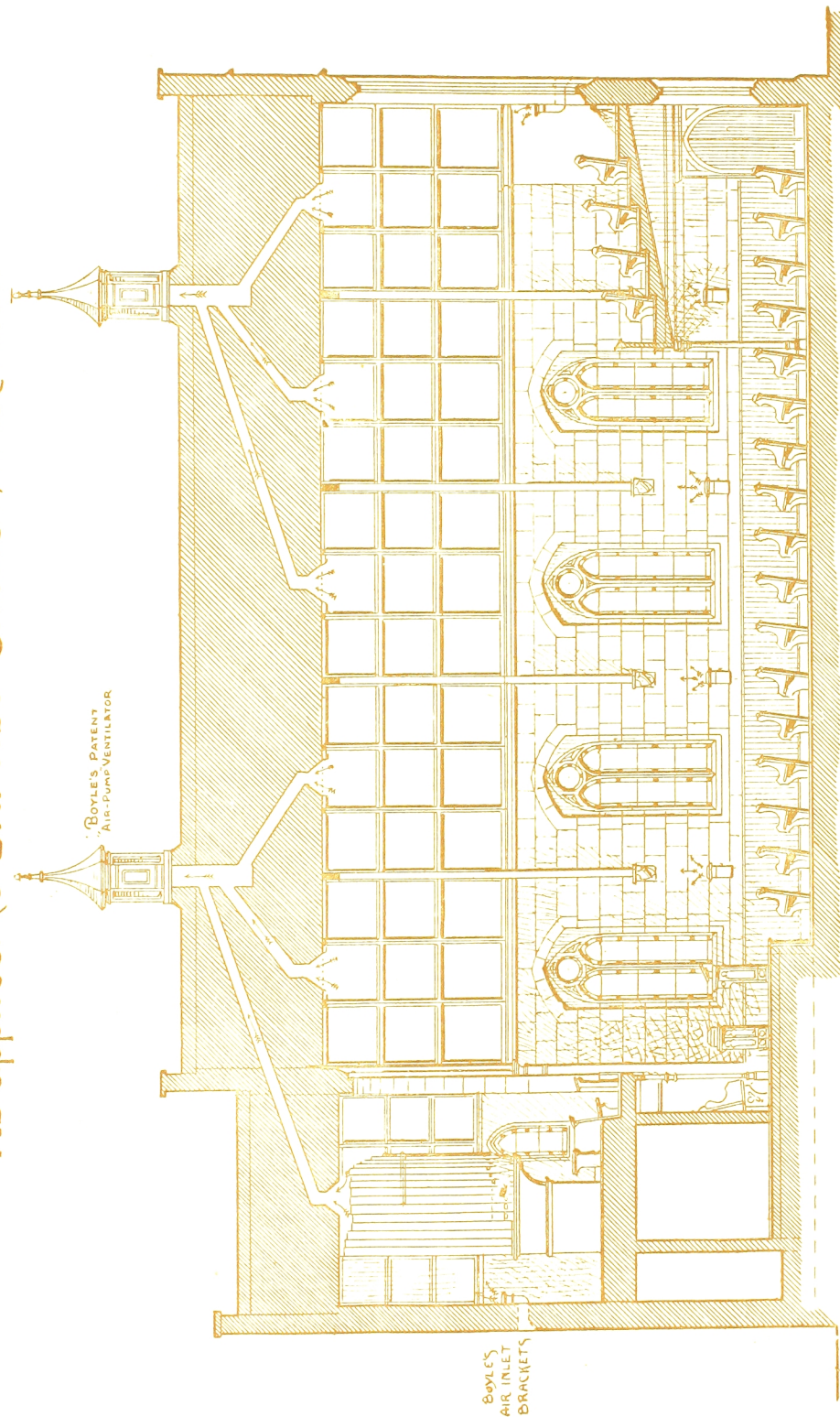
ROBERT BOYLE & SON, L^{TD}
Ventilating Engineers.
LONDON & GLASGOW.

"I regard the Ventilators which you put up for us in St. John's Church as most valuable. We would not on any account be without them. They act well, and keep the Church sweet and pure as regards air, without subjecting us to any draught." —Rev. HENRY D. JONES, *Rector*, St. John's Church, St. Leonards-on-Sea.

N.B. — For table of sizes and number of ventilators required for the ventilation of Churches see pages 148, 149.

THE "BOYLE" SYSTEM OF VENTILATION

As applied to BAPTIST CHURCH, WORTHING.



ROBERT BOYLE & SON, LTD.
Ventilating Engineers,
LONDON & GLASGOW.

"Having adopted your complete system of ventilation for the Worthing Baptist Church, and given it an exceptionally severe test with a well-filled house during very hot and oppressive Sundays in last and this month, we can unhesitatingly speak of it as a great success. The down-draught from which we suffered great inconvenience has been cured, and the vitiated air has been carried out of the building by means of the 'Inlets', and the 'Patent "Air-Pump" Ventilators.' — Rev. C. DOUGLAS CROUCH, Worthing.

N.B. — For table of sizes and number of ventilators required for the ventilation of Churches see pages 148, 149.

THE "BOYLE" SYSTEM OF VENTILATION

As applied to
The CHURCH OF

ST. MARY, REDCLIFFE,
BRISTOL.

BOYLE'S PATENT
"AIR-PUMP" VENTILATOR
(CONCEALED FROM VIEW BY PARAPET)

UNDER THE DIRECTION OF
SIR ARTHUR W. BLOMFIELD A.R.A.



ROBERT BOYLE & SON, LTD.
Ventilating Engineers,
LONDON & GLASGOW.

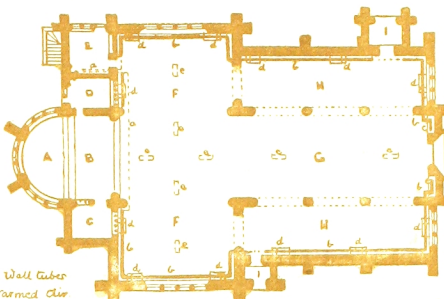
"I have much pleasure in stating that your system of ventilation has answered admirably in the Church of St. Mary Redcliffe."—Rev. CHARLES E. CORNISH, *Vicar*, Church of St. Mary Redcliffe, Bristol.

N.B.—For table of sizes and number of ventilators required for the ventilation of Churches see pages 148, 149.

THE "BOYLE" SYSTEM OF CONCEALED ROOF VENTILATION AND FRESH AIR WARMING as applied to a CHURCH.

REFERENCES

- A SACRARIUM
- B CHANCEL
- C ORGAN CHAPEL
- D SACRISTY
- E CHOIR VESTRY, With Heating App^s Cellar under.
- F TRANSEPTS
- G NAVE
- H AISLES
- I PORCHES.
- a Hot water Mains, 2 diam.
- b Hot water pipes, 4" dia.
- c Hot water Galle
- d Fresh air Inlets, with metal Case round pipes and Wall tubes to deliver warmed air
- e Ventilators in Roof



PART SECTIONAL VIEW

PART LONGITUDINAL SECTION OF NAVE

ROBERT BOYLE & SON, LTD.
Ventilating Engineers,
LONDON & GLASGOW.

This form of ventilator should only be used when, for æsthetic reasons, the turret form of the "Air-Pump" Ventilator—which is the more effective ventilator—cannot be employed.

N.B.—For table of sizes and number of ventilators required for the ventilation of Churches see pages 148, 149.

REPORTS ON
The "Boyle" System of Ventilation
AS APPLIED TO CHURCHES.

*The "Boyle" System of Ventilation has been
successfully applied to over 5,000 Churches.*

REV. E. BARING GOULD,

*Incumbent, St. Michael's Church, Blackheath Park,
London.*

"I beg to say that the 'Air-Pump' Ventilators which you supplied for our Church are thoroughly effective. At the close of a Sunday evening service the atmosphere of the Church used sometimes to be positively pestilential, now, however warm, it is invariably sweet and fresh. Their general success is unquestionable."

REV. ASTLEY COOPER,

Hickey's Chapel, Richmond, London.

"I have much pleasure in bearing my unqualified testimony as to the value of your Ventilators for ecclesiastical buildings. My Chapel was singularly stuffy, and the fumes from the gas at the evening service made the building almost unbearable, but two of your Ventilators on the roof have entirely cleared the atmosphere. The change is most marked and highly appreciated, and, which is a high recommendation there is no down-current."

REV. RICHD. BULMER,

*Congregational Church, Lavender Hill,
London.*

"Your Ventilating Apparatus applied to my Church has proved very successful. It has certainly maintained the purity and freshness of the atmosphere better than any other system of Church Ventilation that I have known."

REV. ROBT. A. RODGERS, *Birmingham.*

"I have very much pleasure in stating that we have now tried your Self-Acting 'Air-Pump' Ventilators in our Church for twelve months, and that we find them fulfilling our best expectations. We have tried several other kinds, and found them either so draughty or altogether inefficient that we have been obliged to give them up. With yours we can keep the atmosphere in the Church quite pure, and that without inconvenience to the congregation from cold and chilling currents of fresh air."

REV. W. SKINNER,

*Congregational Church, Forest Gate,
London.*

"I do not believe there is a better ventilated Chapel or Church in our district."

REV. ARTHUR ALDINGTON,

Cinderford, Gloucester.

"The Wesleyan Church here was one of the worst ventilated I have ever known; atmosphere close and stuffy. Since using your Ventilators there is a wonderful difference."

REV. GILBERT C. TALBOT,

*Church of the Assumption (R.C.), Warwick
Street, London.*

"Since your 'Air-Pump' Ventilators were applied to the Church of the Assumption, Warwick Street, we have been entirely free from the down-draughts which before were very troublesome, and the Church has been far better ventilated in the winter when all windows are closed."

REV. J. W. MILLER,

Presbyterian Church, Leicester.

"We have been much troubled with draughts in our Church and were recommended to try your Ventilators. The result is a great success, we have now no draughts and perfect ventilation."

Ventilation of Schools.

"Air is the prime supporter of life; health; even life itself is dependent upon its purity."—PARKES.

The efficient ventilation of schoolrooms where large numbers of children are congregated, for hours together, is of the very first importance. Healthy bodies make healthy minds, and children who pursue their studies in a pure atmosphere, free from draughts and not overheated, make much greater progress than children who are confined in badly ventilated, overheated, and draughty rooms.

The greatest care should be taken to prevent down-draughts in cold weather, such as proceed from the adjustable ventilators which are commonly fixed in the upper parts of the windows, and which permit a large body of cold air to blow directly into the class rooms and descend upon the heads of the children, cooling and returning the expired and vitiated air to be rebreathed. This is one of the most pernicious forms of ventilation that could be employed in cold weather, and is not only a source of discomfort to the children and the teachers but is a prolific cause of illness and disease.

When windows are utilised for the admission of air it should enter through protected openings at the lower parts and be deflected upwards. This will not only minimise draughts but will ensure more complete diffusion.

A still safer and more satisfactory method of admitting air in cold weather is the employment of air inlet brackets or tubes fixed round the walls at suitable distances from each other and fitted with regulating valves to control the supply. The velocity of the air should not exceed 2 ft. per second if draughts are to be avoided. Ventilating radiators placed in the window recesses not only heat the room but admit a plentiful supply of fresh air warmed to a healthy temperature.

Hot air should never be used for the purposes of ventilation which is also employed to heat the room, as air raised to a temperature such as is required to effectively heat a building is thereby greatly deteriorated, the oxygen being to a certain extent destroyed and the bracing and tonic qualities of the air reduced.

The authorities on the subject are unanimous in condemning this method of heating as undesirable and injurious to health. (See page 28.)

Radiant heat is the healthiest form of heating, as with it the walls can be more effectually warmed than with hot air, and the fresh air supply raised to a comfortable temperature without in the slightest degree injuring it. In warm weather window openings may safely be employed to supplement the ventilation, as there is then not the same danger from draughts as in the winter, when special ventilating arrangements are most required and are, indeed, an absolute necessity.

When the temperature of the air in a class room is 60° to 65° F., the air is expelled from the lungs at a temperature of from 85° to 90° F., and, along with the heated exhalations from the body, ascends with considerable velocity to the upper parts of the room from whence it should be drawn off and not permitted to return to be reinhaled.

The extraction should therefore always be from above, which can easily be effected by the utilisation of the natural forces which are always at work, through the never-ceasing movement which exists in the atmosphere, and without the aid of costly mechanical appliances, which are quite unnecessary and which have not been found in actual practice to be so efficient or reliable as natural ventilation when properly applied. Great care should, however, be taken in the selection of ventilators, as much depends upon their correct construction. The most dangerous form of ventilation is where the air is admitted at the higher parts of the room and forced downwards by mechanical propulsion, as the ascending vitiated air is thereby returned—in opposition to the laws of nature which govern ventilation—to be reinhaled along with the products of combustion and other deleterious matter contained in the air. A high authority justly describes this method of ventilation as "a standing menace to the health of society." When fans are employed for the extraction of the foul air intolerable draughts are set up: they are, therefore, not to be recommended. (See pages 24, 25, 46.)

THE "BOYLE" SYSTEM OF VENTILATION

As applied to a SCHOOL with CENTRAL HALL

A. BOYLE'S PATENT "AIR PUMP" VENTILATORS

B. Main Extraction Shafts

C. Regulating valves

[NOTE.— The whole power of the Ventilators may at any time be applied to either the Central Hall or Class Rooms by opening and closing their respective valves.]

D. Branch Pipes connected with Extraction Flues in Walls of Class Rooms

E. Extraction Flues in walls communicating each with two Rooms

F. Foul air outlet from Class Rooms into Extraction Flues

G. Branch Extraction Pipes from Central Hall

H. Ventilating openings in Ceilings

J. BOYLE'S Air-Inlet Brackets admitting purified Air, may be fitted with Air-warmer, or cooler, as required

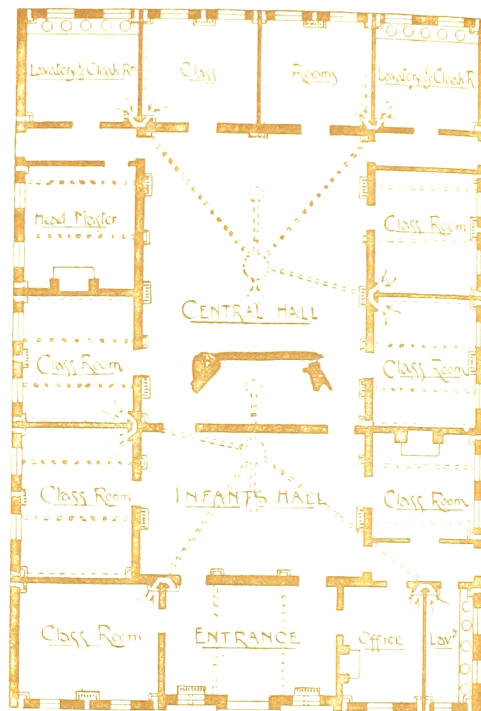
K. BOYLE'S Air-Inlet Tubes admitting purified air, may be fitted with Air-warmer or cooler, as required

L. BOYLE'S Ventilating Radiator admitting warm purified air

M. Fresh air supply pipes to interior tubes and radiators



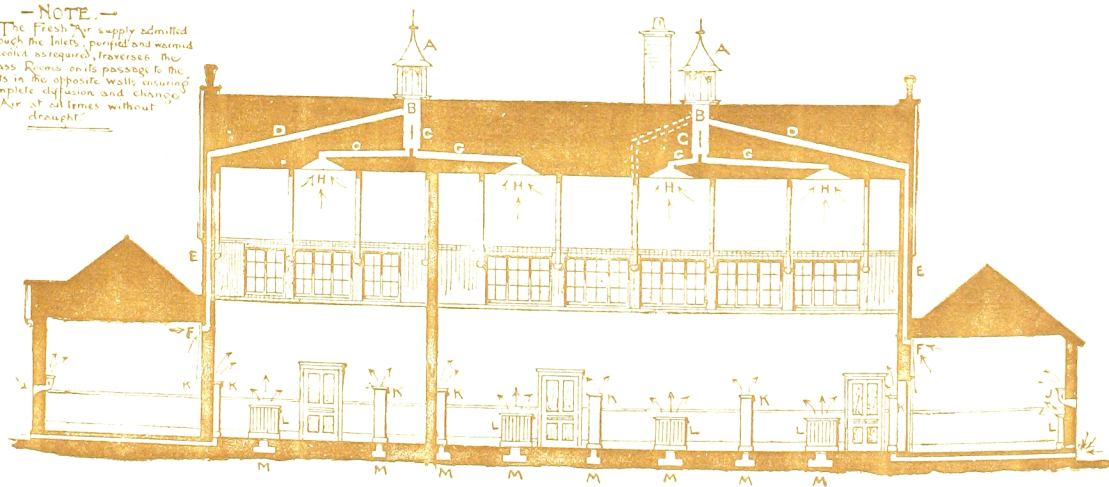
CROSS SECTION



PLAN

NOTE.—

The Fresh Air supply admitted through the Inlets, purified and warmed or cooled as required, traverses the Class Rooms, on its passage to the exits in the opposite walls ensuring complete diffusion and change of Air at all times without draught.



LONGITUDINAL SECTION

ROBERT BOYLE & SON, LTD
Ventilating Engineers.
LONDON & GLASGOW.

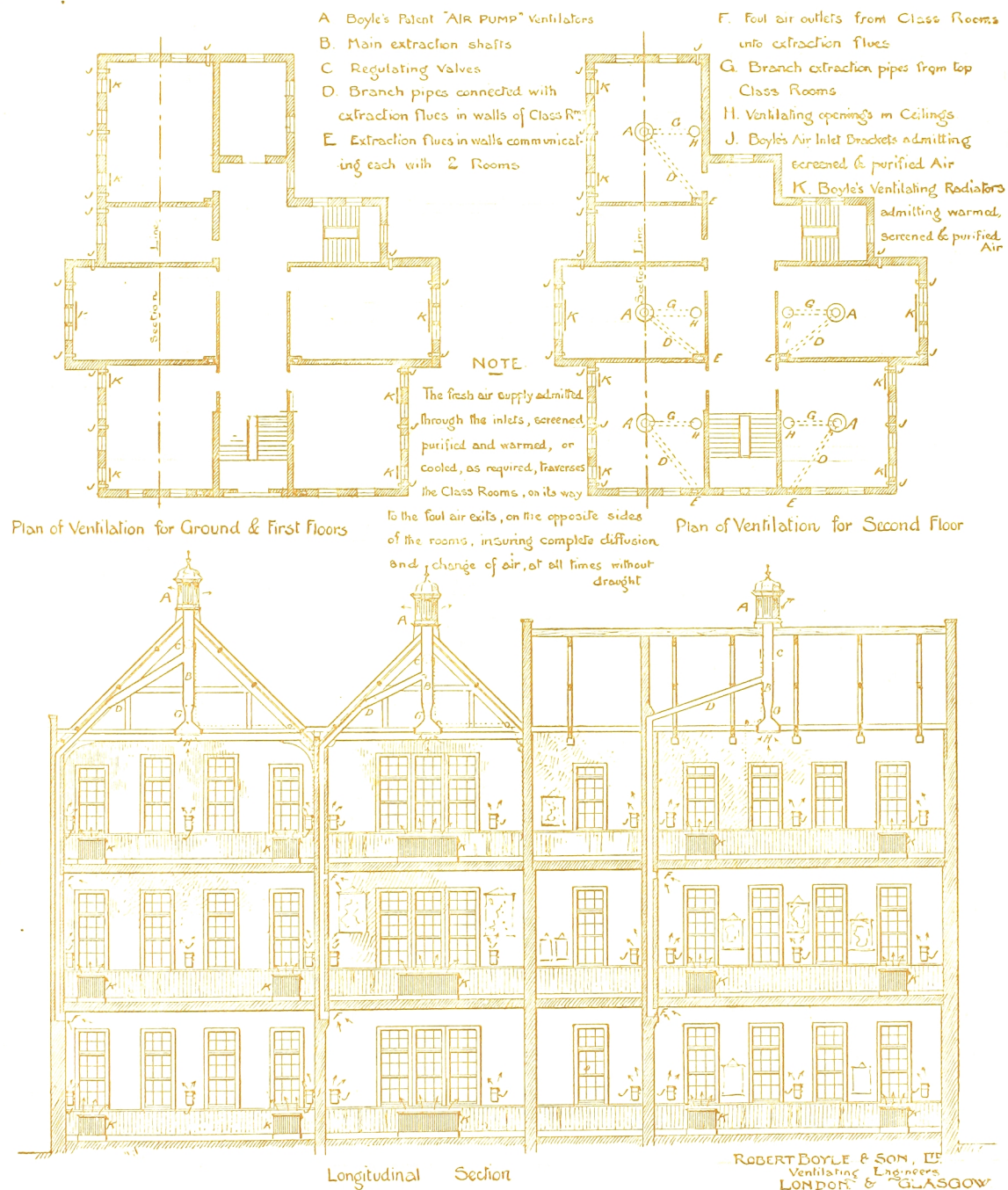
"I have much pleasure in testifying to the efficiency of your system of ventilation. It was applied to these Schools a year ago and has given perfect satisfaction. The rooms used to be unpleasantly stuffy, and H. M. Inspector and others complained of the vitiated atmosphere. Since your ventilators have been introduced the effect has been wonderful. Throughout this very hot summer (1896) the rooms have at all times been pleasant and cool."

—THOMAS CHAPMAN, Head Master, Beddington Central School, Croydon.

N.B.—For table of sizes and number of ventilators required for the ventilation of Schools, see pages 148, 149.

THE "BOYLE" SYSTEM OF VENTILATION

As applied to a Board School

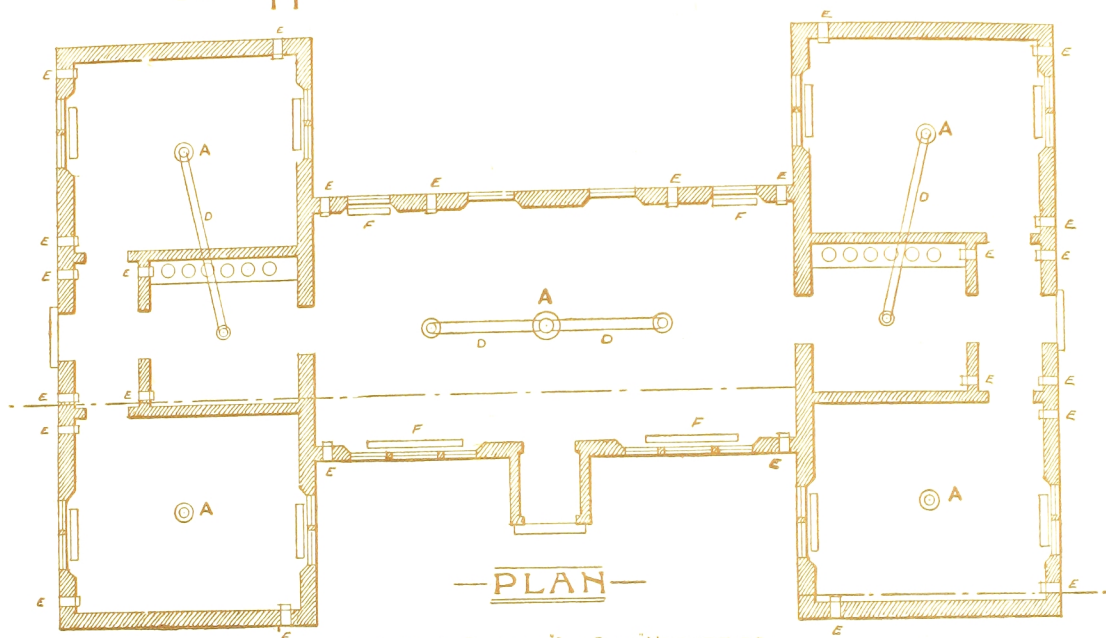


"I cannot speak too highly of the system of ventilation in use at the Board Schools, Church Road, Lowestoft. Our rooms are very full indeed, yet visitors at four o'clock in the afternoon (usually the worst time of the day in a school) have pronounced them 'as sweet and fresh as if no children had been assembled there.'"—
 FREDK. J. RATCLIFFE, *Head Master*, Board Schools, Church Road, Lowestoft.

N.B.—For table of sizes and number of ventilators required or the ventilation of Schools, see pages 148, 149.

THE "BOYLE" SYSTEM OF VENTILATION

As applied to a NATIONAL SCHOOL.



- A. BOYLE'S PATENT "AIR-PUMP" VENTILATORS.
- B. Main Extraction Shafts.
- C. Regulating Valves.
- D. Branch Extraction Shafts connected with Cone over Ventilating openings in ceiling covered on face with perforated panels.
- E. BOYLE'S Air-Inlet Brackets fitted with Air Screens.
- F. BOYLE'S Ventilating Radiators for admitting warmed, screened & purified air.



— LONGITUDINAL SECTION —

ROBERT BOYLE & SON, LTD
Ventilating Engineers.
LONDON & GLASGOW.

"Some years ago this School was in a very insanitary condition, owing chiefly to defective ventilation. Various methods were tried to remedy the evil, with but partial success. Having, however, been recommended by a F.R.I.B.A. to give your 'Patent "Air-Pump" Ventilators' a trial, we had three placed on the roof, and there was an immediate change for the better. I am glad to say that this state of things has been maintained, and the School, instead of being one of the worst ventilated in the district, now ranks amongst the best. It seems little short of marvellous that so great a change should have been made by so little expenditure."—J. B. BAILEY, *Head Master*, National Schools, Maryport.

N.B.—For table of sizes and number of ventilators required for the ventilation of Schools, see pages 143, 147.

REPORTS ON
The "Boyle" System of Ventilation
AS APPLIED TO SCHOOLS.

*The "Boyle" System of Ventilation has been
successfully applied to over 7,000 Schools.*

DANIEL MACANDREW, Esq.,
Architect, Aberdeen University.

"Your system of Ventilation has been applied to nine of the most crowded Class Rooms in Aberdeen University, with great relief to Professors and Students."

M. S. FORSTER, Esq.,
Bursar, Wellington College, Berks.

"I am glad to inform you that the Ventilators placed in four of the large dormitories at Wellington College have proved quite satisfactory, and that we propose to place similar ventilators in four other dormitories."

ARTHUR MOORE, Esq.,
Head Master, Board School, Stifford, Grays.

"Your system of Patent 'Air-Pump' Ventilators was adopted in the erection of the new Schools at Stifford, Grays, and after the test to which they have been put during this excessively hot season (1896) I have no hesitation whatever in pronouncing them perfectly adapted to Schools. On one occasion in particular, on a very hot day when a surprise visit was paid the School by a member of the Board (the Rev. H. H. Allott, M.A., Stifford Rectory), this gentleman was so struck with the coolness of the school atmosphere that a note on the good ventilation was forthwith recorded by him in my Log Book.

REV. J. DUGGAN, Maidstone.

"When my School was built, inlets for fresh air were provided and outlets too; but the outlets, being mere openings, did not act. At the end of an attendance of two hours, the air of the Schoolroom often appeared positively poisonous to anyone who went in from the open air. Your 'Air-Pump' Ventilator was put up several weeks ago, and now the air of the Schoolroom appears to be always nearly as pure as the outside air. There are no down-draughts or draughts of any kind. The improvement is very remarkable, especially when one considers the simplicity of the Ventilator, which is in action day and night without noise, without getting out of order, and without requiring attention."

R. W. B. MOORE, Esq.,
Vicar, Kingsgrove Vicarage, Stoke-on-Trent.

"Your Ventilating appliances in the Kingsgrove Church Schools are completely satisfactory. Even when the rooms are used for crowded meetings or entertainments, the Ventilation now seems perfect."

ARTHUR FOX,
Head Master, Bardsea School, Ulverston.

"I am glad to say that the 'Air-Pump' Ventilators supplied by you for this School a year ago are quite satisfactory. Our corresponding manager has remarked several times on the pureness of the air since they have been in use. Not the slightest down-draught was felt throughout last winter."

E. SCHOFIELD, Esq.,
Head Master, Duckworth Street Schools, Darwen.

"Perhaps the best testimonial I could give to your Self-Acting 'Air-Pump' Ventilator which has been applied to these new Schools, would be to relate an incident which lately occurred. A gentleman, member of a neighbouring School Board, paid a visit in the middle of a warm afternoon this June. He remarked, 'How cool and fresh the air is! There is none of that close, hot foul air, and bad smell which one always finds on entering a Schoolroom.' I have only to add that I believe your system as near perfect as it can be."

PHILIP N. PEAKE, Esq.,
Head Master, Park Street Board School, Wellingboro'.

"I am happy to say they give the greatest possible satisfaction. Though I have had charge of many Schools both in Lancashire and Yorkshire, until now I have never enjoyed the luxury of working in any School in which so perfect a system of ventilation has been carried out."

Natural v. Mechanical Ventilation of Schools.

"The evidence certainly tends to show that artificial ventilation has not proved so satisfactory in actual practice as natural."—BUILDING NEWS.

"After several tests in schools ventilated on each system, it was clearly demonstrated that in none of the schools examined and ventilated mechanically by extraction—even in a new school opened for a week or two—was the air found to be more pure than in those examined and ventilated naturally without any mechanism.

"Draughts existed in the upper levels of every room ventilated mechanically by extraction, while the halls of such buildings were generally full of draughts."—*Extract from a paper on Ventilation read before the Society of Arts, London.*

"The report on the influenza epidemic presented to Parliament by the Local Government Board indicates the extreme importance of proper ventilation, especially in schools.

"The statistics given point to one town, where the schools are mechanically ventilated on the down-draught principle, as being the 'chief focus' of the disease in Scotland. So far as the children in the schools are concerned this is easily accounted for, as the warm, infected air expelled from the lungs is returned by the descending current, and is not only reinhaled, but is also breathed by the other scholars. This is how infection is spread.

"It would require a very powerful and wholly unbearable downward current to entirely overcome the natural upward tendency of the hot respired air; therefore, where the air supply is introduced from above and finds its exit at a lower level, near the floor, rebreathal of the air already used is inevitable and unavoidable.

"It is well known to sanitarians that such a mode of changing the air is inimical to health, being not only a direct cause, but a fruitful means of disseminating disease."—*"Local Government Journal" on Report to Parliament by the Local Government Board.*

"In naturally ventilated schools the cost of the ventilation is but a fraction. With mechanically ventilated schools this comparison cannot be made. To fit up a school for 1,000 children with mechanical ventilation would cost from £400 to £700 more than if one of the ordinary methods were employed."—PROFESSOR CARNELLEY.

"Mechanical ventilation has not worked satisfactorily, and it is still a question whether we have gained by its adoption anything equivalent to the expense."—*Report from the Clerk to the Birmingham School Board.*

"It is a curious fact, and one that should be carefully noted, that in the whole of the report not one single instance is given of the mechanical system having been tested against, or even compared with, any automatic system, the schools mechanically ventilated being tested against schools having *only the windows and doors to rely upon for ventilation—that is to say, schools in which no system of ventilation existed at all.* It would have been interesting to have known what the results would have been had a good natural system been in use applied under equally skilled advice as the mechanical. . . . The deductions arrived at are, for all scientific or practical purposes, valueless, as they prove no more than that an elaborate and costly system of mechanical ventilation has been found in a few instances to be slightly more effective than where there was no system of ventilation in use at all.

"Architects and School Boards contemplating the adoption of mechanical ventilation would do well to first satisfy themselves that the outlay would be justified by the results and whether the same, or better results, might not be secured by simpler and less costly methods; the results attained in other quarters certainly point in that direction."—*Building News.*

Ventilation of Hospitals and Asylums.

"The evidences of injury to health from impure air are found in a larger proportion of ill-health—i.e., of days lost from sickness in the year—than under other circumstances; an increase in the severity of many diseases, which, though not caused, are influenced by impure air, and a higher rate of mortality."—PARKES.

In warm weather, when there is but little difference between the inside and outside temperature, windows may safely be utilised for the admission of air. Care should, however, be taken that the incoming air does not blow directly on to the patients. In towns or cities canvas or copper wire screens should be fixed across the openings to filter the air and break the force of the current. These screens should be cleansed at short periods.

In cold weather, when the heating arrangements are in operation, it is necessary to make special provision to admit the air without draught, and in such a manner as to ensure the most complete diffusion and an equable movement throughout the ward. A number of small air inlets fixed round the walls at a height of about 5 ft. 9 in. ensures the best distribution. The air should pass directly through the openings in the walls into the tubes or brackets, and be delivered in an upward direction at a velocity not exceeding 2 ft. per second. These inlets should be fitted with filters and regulating valves, and be easy of access for cleansing purposes.

Long air channels should be avoided as they harbour dirt, and are difficult of access. When the air supply is warmed by passing through a ventilating radiator, it may be admitted at a low level.

Inlet openings under the beds are not to be recommended unless provision be made for warming the incoming air in cold weather, otherwise a disagreeable draught on the feet of the attendant nurses and doctors would result.

In the winter, when the external air is cold and heavy, if windows are opened at the top, the air upon entering immediately descends, owing to its greater density, and presses down and returns the ascending exhausted air to be rebreathed. This down-draught cannot but prove injurious to the patients as well as to the other occupants of the ward. Open windows should, therefore, never be resorted to in cold weather. The vitiated air should be extracted at the ceiling level to where it naturally ascends and never allowed to return to be rebreathed.

The authorities on the subject recommend a natural method of ventilation in preference to mechanical or other artificial arrangements, as, when properly planned, it is found to be at least equally as effective, and more easily and cheaply applied than artificial ventilation. (See pages 52, 53.)

Dr. Parkes says, "For Hospitals natural ventilation certainly seems the proper plan."

Mechanical ventilation, either by propulsion or extraction, is undesirable on account of the draughts created. (See pages 23, 24, 25.)

Sir Douglas Galton, in "Hospital Construction"—referring to the mechanical ventilation of hospitals with respect to its complicated and unreliable character—says: "The more the question is examined, the more advisable does it appear to adhere to simplicity in all details of hospital construction."

Ventilation by means of hot-air aspirating shafts has seldom proved satisfactory, and it is a very expensive plan. (See page 54.)

Downward ventilation by propulsion, or forcing air in at the higher parts of the wards and permitting it to escape at a lower level, is a total inversion of the laws of nature which govern ventilation and as such is correspondingly defective, as the powerful ascensional movement of the warm expired air which is expelled from the lungs at a temperature of 85° to 100° F. instead of being employed as an aid to the ventilation, as with a natural system, is an obstacle which has to be overcome by the expenditure of a great deal of power, for which there is no equivalent return, before the system can be said to be operative. Only what would prove a wholly unbearable down-draught could possibly prevent the warm expired air from ascending, which, with this system, is returned to be rebreathed along with the products of combustion and other impurities.

With down-draught ventilation by propulsion from three to four times the volume of air is required than is necessary with the upward method, constituting it a very expensive system. (See pages 26, 27.)

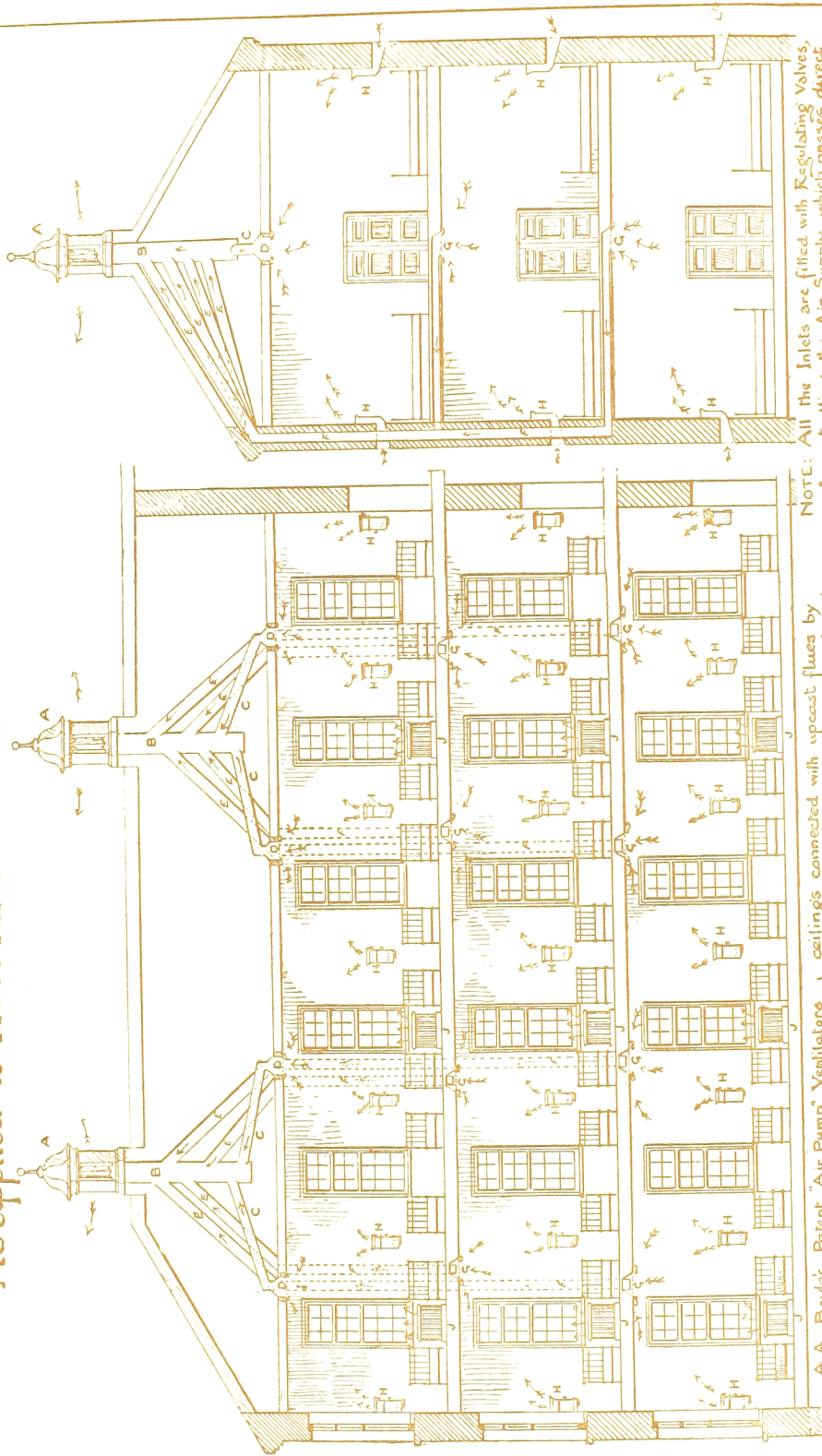
Open fireplaces in wards should never be employed as foul air exits, as the upper strata of heated impure air is drawn downwards towards the fire and rebreathed by the occupants of the ward. Provision should be made for a separate supply of air to the fires, so that they will not draw from the wards or unduly interfere with the ventilating arrangements. If it is desired to utilise the up-draught created by the fire, a mica flap valve might be fixed in the flue immediately below the ceiling.

It may be accepted as an axiom in ventilation that the warm exhausted air which naturally ascends, should never under any circumstances be permitted to return to the breathing zone, and any method of ventilation which admits of this is not only worse than useless, but is a positive danger to health, and completely fails to achieve the object in view.

The wards of an hospital or the dormitories of an asylum should never be heated by hot air.

If the fresh air supply is raised to a temperature such as is necessary to efficiently heat a building, its health-giving properties are thereby considerably deteriorated, and the oxygen it contains being partially destroyed it is rendered unsuitable for healthy respiration. (See page 28.)

THE "BOYLE" SYSTEM OF VENTILATION As applied to HOSPITALS & ASYLUMS



A.A. Boyle's Patent "Air Pump" Ventilators
B.B. Main Extraction Shafts
C.C. Branch Extraction Shafts connected direct with Foul Air Exit openings D.D.
E.E. Branch Extraction Shafts connected with Upcast Flues F.F. constructed in walls
G.G. Foul Air Exit openings in centre of

ceilings connected with upcast flues by shafts between joists in channels formed in concrete floor
H.H. Boyle's Air Inlet Brackets for admitting screened purified Air; may be fitted with Air-warmers or Disinfecting Chambers
J.J. Boyle's Ventilating Radiators, admitting warmed, screened, and purified Air.

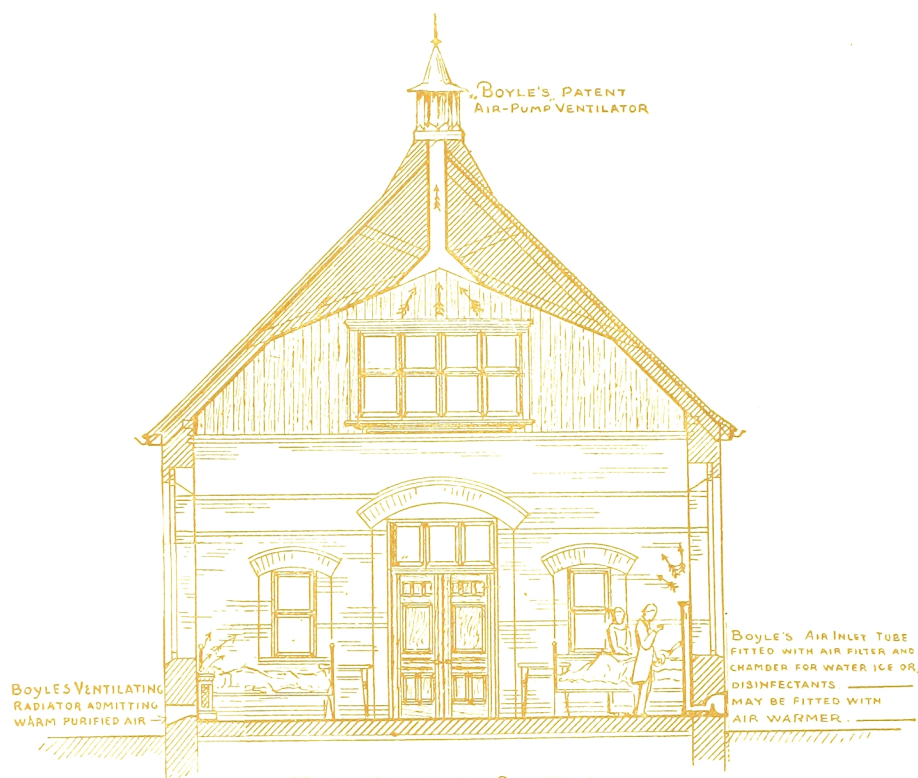
NOTE: All the Inlets are fitted with Regulating Valves, for controlling the Air Supply, which passes direct from the outside into the Building.

ROBERT BOYLE & SON, L^{TD}
Ventilating Engineers,
LONDON & GLASGOW.

"The ventilation seems to be perfect."—LORD CLIFFORD (*Member of the House of Lords Committee on Hospitals*) on the "Boyle" System of Ventilation as applied to the new Workhouse Infirmary, Newton Abbot, 1898.

N.B.—For table of sizes and number of ventilators required for the ventilation of Hospitals and Asylums, see pages 145, 149.

THE "BOYLE" SYSTEM OF VENTILATION As applied to an INFECTIOUS DISEASES HOSPITAL.



TRANSVERSE SECTION.



LONGITUDINAL SECTION.

SHOWING INLETS FOR FRESH AIR AND EXTRACTION TUBES

NOTE:—Fresh purified air, warmed or cooled, admitted underneath beds where desired.

ROBERT BOYLE & SON, LTD.
Ventilating Engineers,
LONDON & GLASGOW.

"In reply to your request that I should tell you how the 'Air-Pump' Ventilators recently fixed in the new building here are answering, I am able to inform you that they appear to fulfil their object in a completely satisfactory manner."
—DR. F. FOORD CAIZER, *Medical Superintendent*, South Western Fever Hospital, London.

N.B.—For table of sizes and number of ventilators required for the ventilation of Fever Hospitals, see pages 148, 149.

REPORTS ON The "Boyle" System of Ventilation as applied to Hospitals and Asylums.

The "Boyle" System of Ventilation has been successfully applied to over 4,000 Hospitals and Asylums.

NEW WORKHOUSE INFIRMARY, NEWTON ABBOT.

Ventilated throughout with the "Boyle" System of Ventilation, embracing Boyle's Patent "Air-Pump" Ventilators and Air Inlets.

Extracts from speeches made at the opening of the Infirmary on January 6th, 1898.

COLONEL WALCOTT, *Chairman of the Building Committee.*

"The arrangements for keeping the rooms full of fresh air are excellent. . . . Twelve Boyle's Fresh Air Inlets have been erected in each of the wards. . . . The ventilation is splendid."

LORD CLIFFORD, *Member of the House of Lords Committee on Hospitals.*

"There is a sense of comfort about this Infirmary which will be greatly valued by the inmates. . . . The ventilation seems to be perfect."

MR. THOMAS PRESTON FLOWERS, *Poor Law Inspector to the Local Government Board.*

"Here you have a building which, in a pre-eminent sense, presents the idea of comfort which should properly belong to such a place . . . and carried out upon a scheme of ventilation which entirely removes every notion of stuffiness, and provides abundance of fresh air."

Lieutenant-Colonel MANUEL CANO,
Madrid.

"I have to state that from the use which I have made of Robert Boyle & Son's Ventilators as applied under my direction to the new Military Hospital, Caranchel, for the garrison of Madrid, I have obtained results so satisfactory that I have no hesitation in recommending them for all hygienic buildings by reason of their simplicity, convenience, and efficiency."

Dr. J. C. STEELE, *Superintendent,*
Guy's Hospital, London.

"There can be small doubt of the efficiency of this contrivance" (Boyle's Patent "Air-Pump" Ventilator).

Dr. ARTHUR G. BLOMFIELD,
Devon and Exeter Hospital, Exeter.

"I am satisfied with the beneficial results as regards the ventilation."

Dr. EDWARD SERGEANT,
Medical Officer of Health, &c., Bolton.

I am glad to be able to state that your 'Air-Pump' Ventilators seem to have performed their work at the Bolton Fever Hospital very satisfactorily."

Senor JOSE GRASES RIERA, *Architect-in-Chief,*
Madrid.

"I have great pleasure in informing you that Boyle's Ventilating System, which you fitted up in 1896 at the Princesa Hospital, Madrid, has produced results which are unsurpassable, and continues to act with great regularity without there having been the slightest hitch during the two years it has been in use."

J. F. FULLER, Esq., *Architect,* Dublin.

"Your system of ventilation has been very successful in the new wing of the Killarney Asylum."

Dr. GEORGE MORGAN,
Royal Alexandra Hospital, Brighton.

"The whole of the new part of this Hospital is fitted with Boyle's Ventilators, and I should say they give universal satisfaction."

Dr. P. CHATTERTON, *late House Physician,*
Hôtel Dieu, Paris.

"My pursuits have rendered me practically acquainted with many systems of Ventilation now in use, both automatic and otherwise, and after careful examination I have arrived at the conclusion that your system is not only the simplest but the most efficacious I have yet met with."

Experiments

WITH

The "Boyle" System of Ventilation

APPLIED TO THE

Small-pox Hospital Ship "Castalia."

(Metropolitan Asylums Board.)

"ONE of the wisest acts of the Metropolitan Asylums Board, since its formation, was the acquirement of the *Castalia* (which was originally built on the twin principle for the prevention of sea sickness), and the conversion of the vessel into a small-pox hospital on the Thames. The deck area being extensive, it has been found practicable to construct several pavilions and to arrange them in such a way as to ensure the largest amount of light for each, in addition to unimpeded ventilation. These advantages are important when it is remembered that 200 patients can be received in the *Castalia*. Knowing that in many hospitals there is inefficient ventilation, the Metropolitan Asylums Board invoked the aid of several experts on the subject, Professor de Chaumont being the principal adviser. After careful inquiry, it was decided to adopt Messrs. Robert Boyle & Son's system of ventilation as being the best and most suitable for the purpose. The Local Government Board approved of the selection, and Messrs. Boyle duly received instructions to proceed with the work.

"As this is one of the largest and most important ventilating contracts that the firm has yet undertaken, and is considered to be one of the most unique examples of ventilation in this country, or indeed in the world, it is deserving of a detailed notice. For the extraction of the vitiated air there are provided twenty of the Self-Acting 'Air-Pump' Ventilators, each six feet in diameter, connected with the wards by means of iron shafts, measuring from thirty inches to four feet in diameter. There are also sixteen 'Air-Pump' Ventilators, three feet in diameter, connected with the water-closets, lavatories, bath room, and other offices. Fresh air is admitted all round the wards by means of openings cut through the walls at the floor level. The air passes over hot-water pipes which are encased in a false skirting made of iron, perforated at the top to permit of the air being equally and imperceptibly filtered in and diffused throughout the wards. The supply of air is regulated by valves or shutters worked by means of screws as arranged by Mr. Adam Miller, the Engineer to the Board.

"Several scientific and medical men watched the progress of the work, and much interest was excited as to how it would answer. Experiments were therefore instituted by the Board in order to test the efficiency of the system. The results were most

satisfactory; indeed, they are stated to have been far beyond anything that was anticipated. After an extended series of experiments to test the 'Air-Pump' Ventilators under atmospheric changes, such as when there was a good wind blowing, and when there was no wind at all, it was found that the ventilators extracted at the average rate of 5,000,000 cubic feet of air per hour, the air in the wards being entirely changed once in every five minutes, whilst there was not the least disagreeable draught. During the whole of the tests no appearance of a down-draught was found in the ventilators. Several anemometers were placed in the shafts of the ventilators, and the readings were taken every two hours. Anemometers were also fixed outside to register the velocity of the wind. Messrs. Boyle were not present at any of these tests except the first, the engineers and experts appointed by the Asylums Board being alone entrusted with the trials. Dr. Bridges, Chief Inspector of Hospitals, after carefully investigating the system, expressed his full approval of its action, informing Messrs. Boyle that even when he tested it in a calm, he found a considerable up-draught in the shafts, and at no time any down-draught. Sir Charles Dilke and other members of the Royal Commission on the Dwellings of the Poor visited the *Castalia*, for the purpose of examining the arrangements, and expressed themselves satisfied with all they saw. Messrs. Boyle applied their system to the *Castalia* under a guarantee, and it is evident that the Asylums Board was satisfied that all the stipulated requirements had been fulfilled, and the system a success, when it is mentioned that immediately after the conclusion of the experiments their account was paid. The system is also applied to the ambulance and transport steamers *Redcross*, *Endymion*, and *Albert Victor*.

"From their practical character, the value of these experiments must be very great, as they demonstrate the true worth of Messrs. Boyle's system and its capabilities.

"There is only one trustworthy way of proving the efficiency of any ventilating arrangements, and that is by actual and extended practical experience. Lecture-room experiments, as all privately conducted experiments can only be called, may be all very well in theory, and show certain results, but in actual practice the results are generally found to be very different."—*Architect*.

Ventilation of Hospitals.

(Mechanical.)

"Any method of ventilation which depends upon mechanical or artificial means for its action cannot be reliable, and therefore is not to be recommended."—PROFESSOR CORFIELD (Professor of Hygiene and Public Health, University College, London).

"Experience would seem to justify the hesitation which has been felt with respect to artificial ventilation. The following quotation from the Report of the Barracks and Hospital Improvement Commission explains this partly:—

"In one hospital we examined, which was ventilated by one of the most perfect apparatus [mechanical] we have anywhere seen, and which professed to supply between 4,000 and 5,000 cubic feet of air per bed per hour, we found the atmosphere of the wards stagnant and foul to a degree we have hardly ever met with elsewhere. We at once pointed out this circumstance. An inquiry was immediately instituted, when it appeared that one of the valves of the supply-pipe had been tampered with, for no other reason, that we could perceive, except to save fuel by diminishing the quantity of warm air supplied to the sick. The ventilation, in this case, was worse than a delusion."

"The writer has visited, on several different occasions, three of the important hospitals in Europe and the United States of America in which the ventilation depended on propulsion, and on every occasion the propulsion happened to be out of use for the time. . . .

"Methods of artificial ventilation are more or less dependent upon careful training in the assistants. They may answer well when first put into operation, but the arrangements, in their simplest form, present some complications and require some special knowledge for their efficient working. Hence the changes in *personnel* which necessarily take place in the course of time may introduce want of appreciation or of care in the management. Moreover, the continuous cost of working presses upon the resources of voluntary hospitals.

"The more the question is examined, the more advisable does it appear to adhere to simplicity in all details of hospital construction. . . .

"The author visited a hospital recently in which the ventilation was by propulsion. The amount of fresh air which was entering the wards was stated to be at the time at a rate of over 5,000 cubic feet per patient per hour, and yet there was a distinct feeling of relief and freshness on passing from the ward to the open air. . . .

"Surgeon-General Billings of the United States Army, mentioned an experiment in the Barnes Hospital, Washington, where fresh-air inlets for warmed air were placed near the ceiling, and extraction outlets in the floor.

"In this experiment it was found, that when warm air was admitted near the ceiling there was a difference of ten degrees in the temperature between the floor and the ceiling, and that the patients complained of cold feet and discomfort.

"Surgeon-General Billings also remarks that when the warm air is introduced near the ceiling it is impossible to vary the temperature at different beds, a thing which it is often desirable to accomplish in a hospital."—*Hospital Construction*, 1893 (SIR DOUGLAS GALTON, F.R.S.).

"Having regard to the temperate character of the British climate, we have yet to be convinced that it is desirable or necessary to introduce artificial ventilation into our hospitals. . . . At Guy's Hospital (new building) the artificial system can be compared with the natural system in the older wards; and the result of the comparison certainly does not make for the superiority of the former method."—*Hospitals and Asylums of the World*, 1893 (SIR HENRY BURDETT).

Ventilation of Hospitals.

(Natural v. Mechanical.)

"The system of propulsion for hospital ventilation has not found general favour with hospital Architects or Managers in this country."—SIR DOUGLAS GALTON, F.R.S.

"There would be a difficulty in effectively ventilating hospitals by propulsion. The results might easily be mischievous rather than beneficial."—DR. FRANCIS VACHER.

Extracts from a paper read by Mr. KEITH D. YOUNG, F.R.I.B.A., before the Architectural Association, London, November 23rd, 1894.

"I cannot think it justifiable for the sake of those few days [when natural ventilation in this country might not be fully operative] to establish a complicated system, involving a certain amount of skilled labour in working and considerable cost for maintenance.

"The question which concerns us is this: Is there any evidence to prove that wards cannot be kept sufficiently sweet and healthy without recourse to expensive appliances? So far as the experience of hospitals in this country goes, I think that not only is there no such evidence, but that there is some very definite evidence in support of the exact converse.

"There is a case cited by Dr. Bristowe and Mr. Holmes in the report to which I have before alluded, which goes to prove that mechanical ventilation can become a positive evil.

"In the discussion which followed,

"Mr. ALEXANDER GRAHAM, F.S.A., said he was very glad to hear Mr. Young advocate natural means of ventilation. . . . He was pleased to hear Mr. Young condemn some of the mechanical systems, for he never heard of one which was perfect in action, and he was sure they were very expensive.

"Mr. GORDON SMITH, F.R.I.B.A. (Architect to the Local Government Board), said in the main he endorsed all that Mr. Young had said in his condemnation of mechanical ventilation.

"Dr. E. A. FARDON (Resident Medical Officer, Middlesex Hospital), said he had inspected many mechanical systems of ventilation, including those at the Houses of Parliament and the Law Courts, and had never seen one that was approved by those who used it. He thought the importance attached to uneven temperatures in wards was overrated."

"The really important point to be kept in view in regard to ventilation is, that before any system depending upon mechanical contrivances can be pronounced worthy of adoption, it must be demonstrated beyond dispute that it is not only as good as ordinary methods, but appreciably better. For nothing but a substantial improvement would justify the largely increased cost, both of construction and maintenance, necessarily consequent on the adoption of mechanical ventilation."—*Hospitals and Asylums of the World*, 1893 (SIR HENRY BURDETT).

Ventilation of Hospitals.

(Hot Air Aspirating Shafts.)

"The employment of heat to create an induced upward current is not only a costly, but an unsatisfactory method of ventilation"—VENTILATION.

Ventilation when attempted to be secured by heating the air in a shaft has seldom proved successful. This is chiefly owing to the downward pressure of the cold external air cooling the hot ascending air and impeding its exit.

This might be avoided if a properly constructed ventilator were fixed on the top of the shaft to remove the air pressure, assist the extraction, and prevent down-draught, which, with the louvre-board turret generally employed, usually occurs.

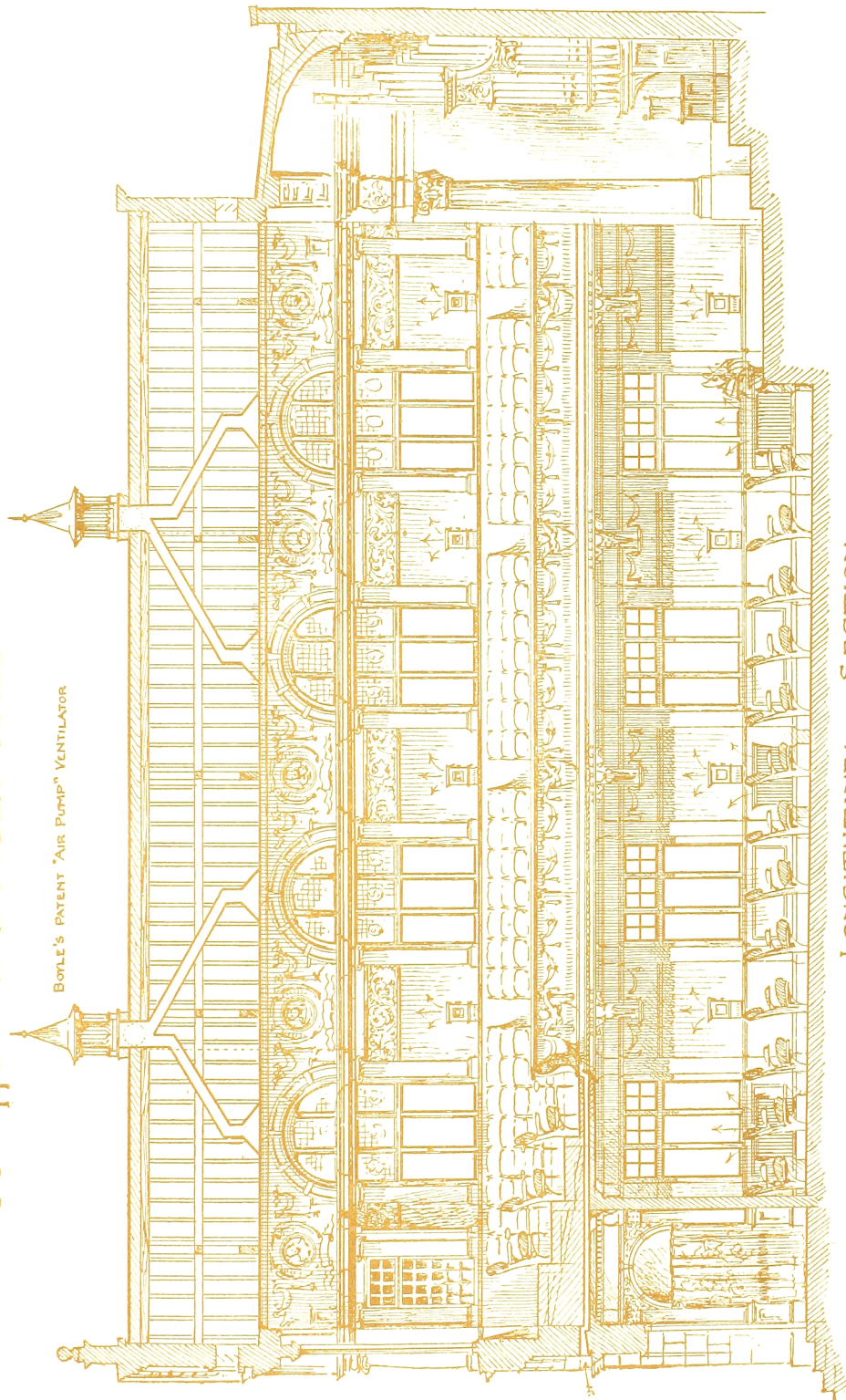
This form of ventilation is now practically discarded as "not in accordance with the views of modern engineers, or with their ordinary practice."

"The Western Infirmary, Glasgow, is ventilated by means of hot water coils placed in shafts communicating with louvred turrets on the roof in which are placed hot water cylinders; on testing this system a strong down-draught was experienced, flocks of cotton wool being driven with considerable force down the shafts. At no time during the experiments was there any abatement in the down-draught, or the slightest tendency to an up-draught."—*Ventilation*.

"The history of St. Mary's Hospital [London] affords some instructive lessons in ventilation. In their report on this hospital, Dr. Bristowe and Mr. Holmes referred to the existence of a central shaft for extracting the foul air from the wards in which a fire was always kept burning. They said 'the Secretary informed us, however, that there was reason to suppose the whole apparatus is a failure; that Dr. Sanderson had made numerous experiments which led him to the conclusion that the orifices of exit in the wards act little, if at all, and very often admit air instead of carrying it off, and that there is, in fact, rather a circulation of air in the shaft than an escape of air from it.' In summing up their conclusions these gentlemen said: 'The hospital cannot certainly be regarded as a healthy one, for most of the diseases which constitute unhealthiness in a hospital seem to prevail in an unusual degree, and there seems also to be considerable spread of infectious fevers.'"—*Hospitals and Asylums of the World* (1893).

"At this hospital [Bristol General Hospital] an apparatus was set up which consisted of a shaft in the garden from whence air was drawn into the basement, where it was heated by passing over a series of hot pipes; from thence the warm air went to the wards. The foul air from the wards was drawn out by a series of shafts communicating with a central tower in which an up current was induced by heated flues, but after a short trial it was found that the hospital was becoming infected with erysipelas, and it was abandoned."—*Hospitals and Asylums of the World* (1893).

THE "BOYLE" SYSTEM OF VENTILATION As applied to a PUBLIC HALL.



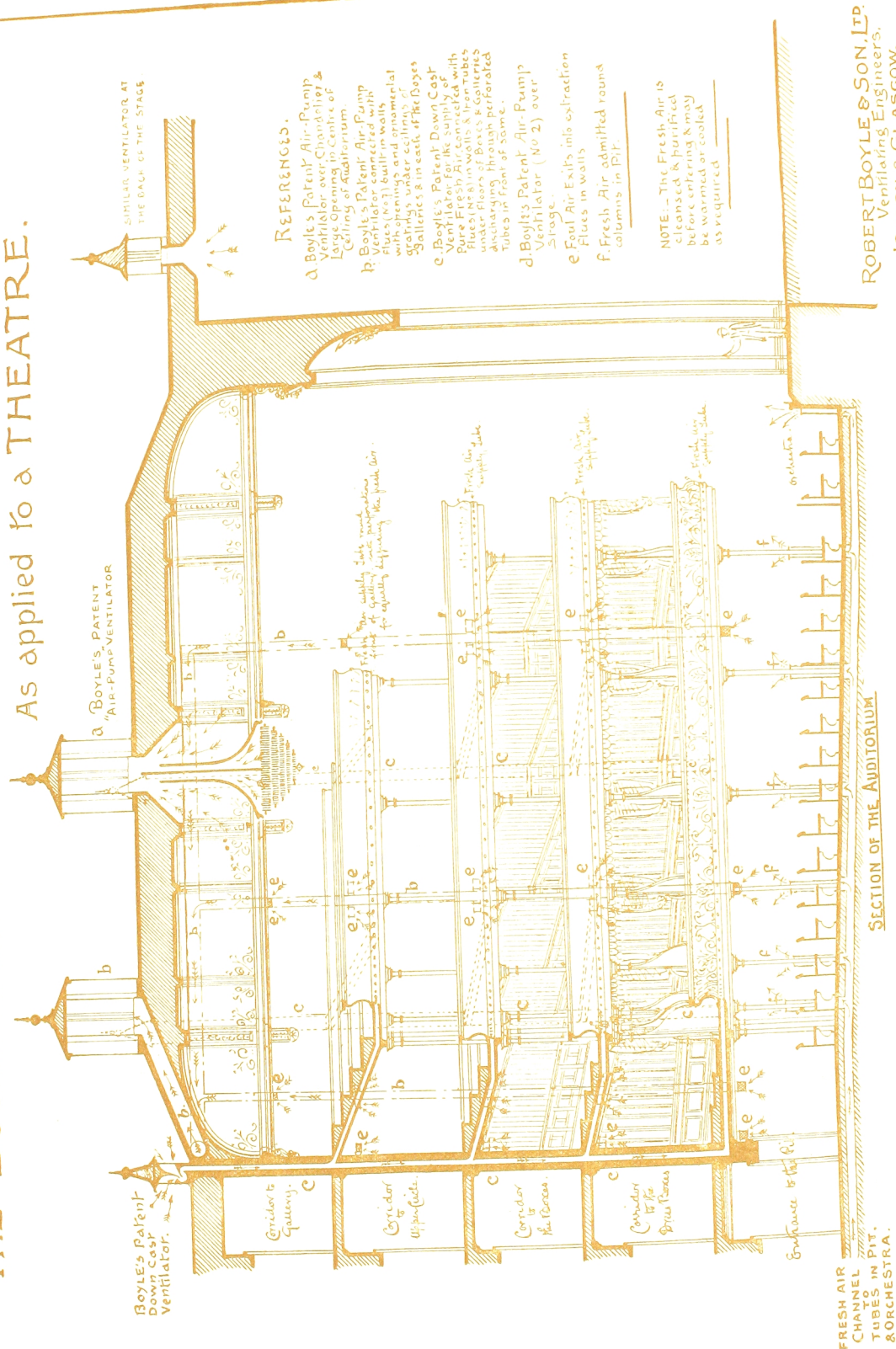
LONGITUDINAL SECTION

ROBERT BOYLE & SON, LTD.
Ventilating Engineers
LONDON & GLASGOW

"The favourable opinion which I had formed of Mr. Boyle's 'Air-Pump' Ventilator has now been confirmed by its successful application to various buildings under my charge. It has been fitted up in several of our Public Buildings, including the Corporation Halls, Picture Galleries, &c. In every case it has given perfect satisfaction, and I have no hesitation in recommending it as one of the most efficient and economical systems of ventilation of the day."—JOHN CARRICK, *City Architect, Glasgow.*

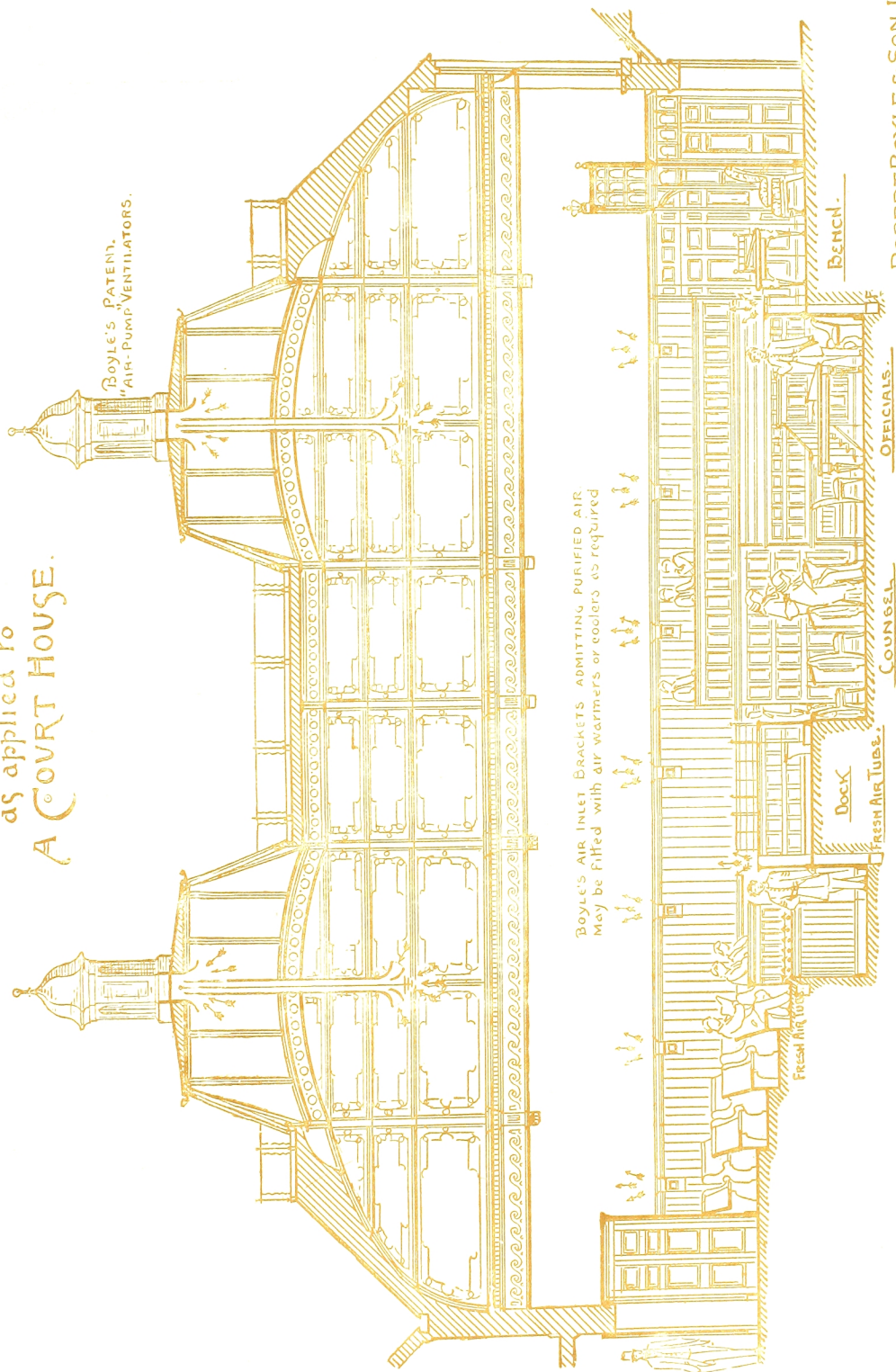
N.B.—For table of sizes and number of ventilators required for the ventilation of Public Halls, see pages 148, 149.

THE "BOYLE" SYSTEM OF VENTILATION As applied to a THEATRE.



"The notoriously unhealthy state of the air in nearly all Theatres, and the intolerable draughts which usually exist, are a discredit to our boasted nineteenth century progress in matters sanitary. It is well known to medical men that the impure air generally found in Theatres is a prolific source of illness and disease, and many people stay away for that reason alone."—VENTILATION.

THE "BOYLE" SYSTEM OF VENTILATION as applied to A COURT HOUSE.

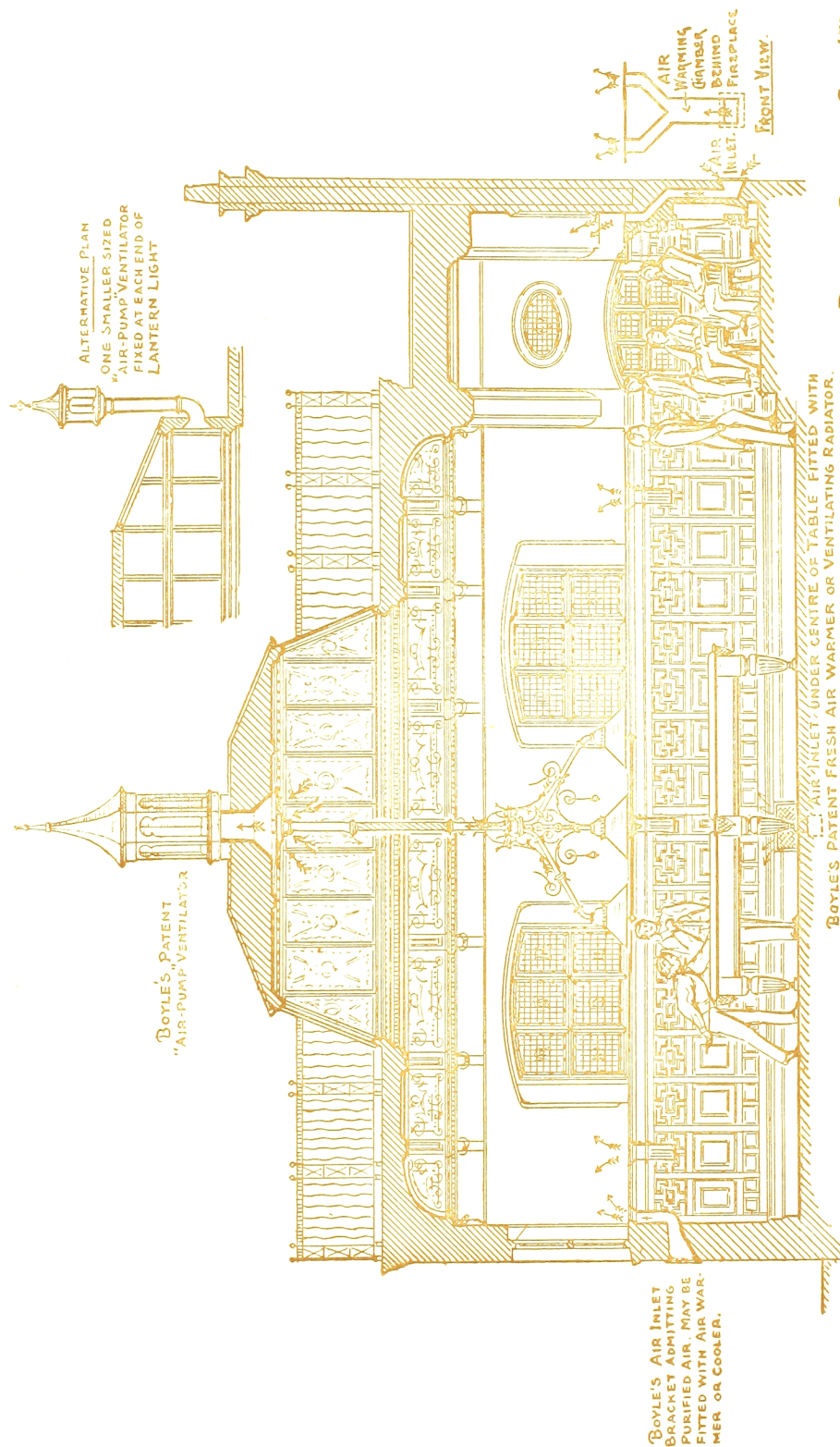


ROBERT BOYLE & SON, LTD.
Ventilating Engineers.
LONDON & GLASGOW.

"I have the honour to acknowledge your letter of the 2nd inst., and to inform you in reply, that since the supply of Air Tubes and your 'Air-Pump Ventilators, I have been quite satisfied with the ventilation of this Court."—TEMPLE C. MARTIN, *Chief Clerk*, Lambeth Police Court, London.

THE "BOYLE" SYSTEM OF VENTILATION

As applied to a BILLIARD ROOM.



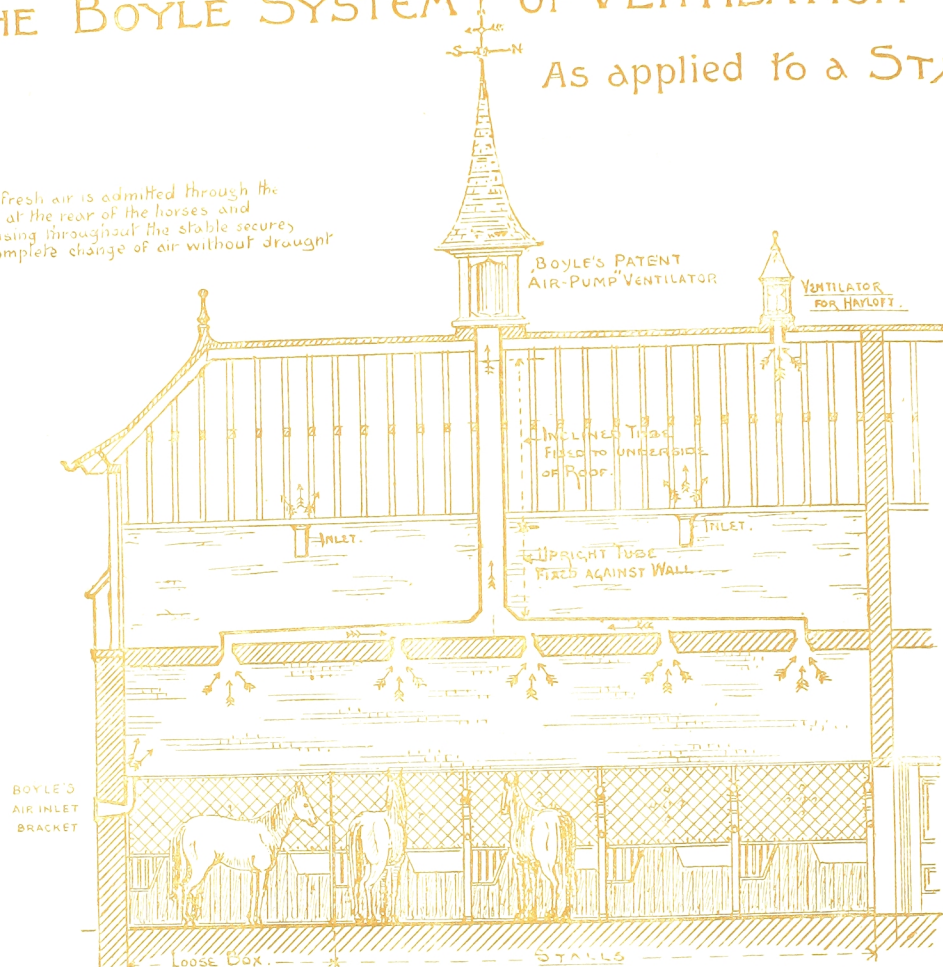
ROBERT BOYLE & SON, LTD.
Ventilating Engineers.
LONDON & GLASGOW.

"Our large Billiard Rooms are fitted with your ventilators, and I have great pleasure in pronouncing them perfect."—JAS. BEDDINGTON,
Manager, Conservative Club, Nantwich.

N.B.—For table of sizes and number of ventilators required for the ventilation of Billiard Rooms, see pages 148, 149.

THE "BOYLE" SYSTEM OF VENTILATION As applied to a STABLE

NOTE: The fresh air is admitted through the wall at the rear of the horses and diffusing throughout the stable secures a complete change of air without draught.



SECTION SHEWING EXTRACTION OF FOUL AIR FROM STALLS
ABOVE HORSES HEADS.



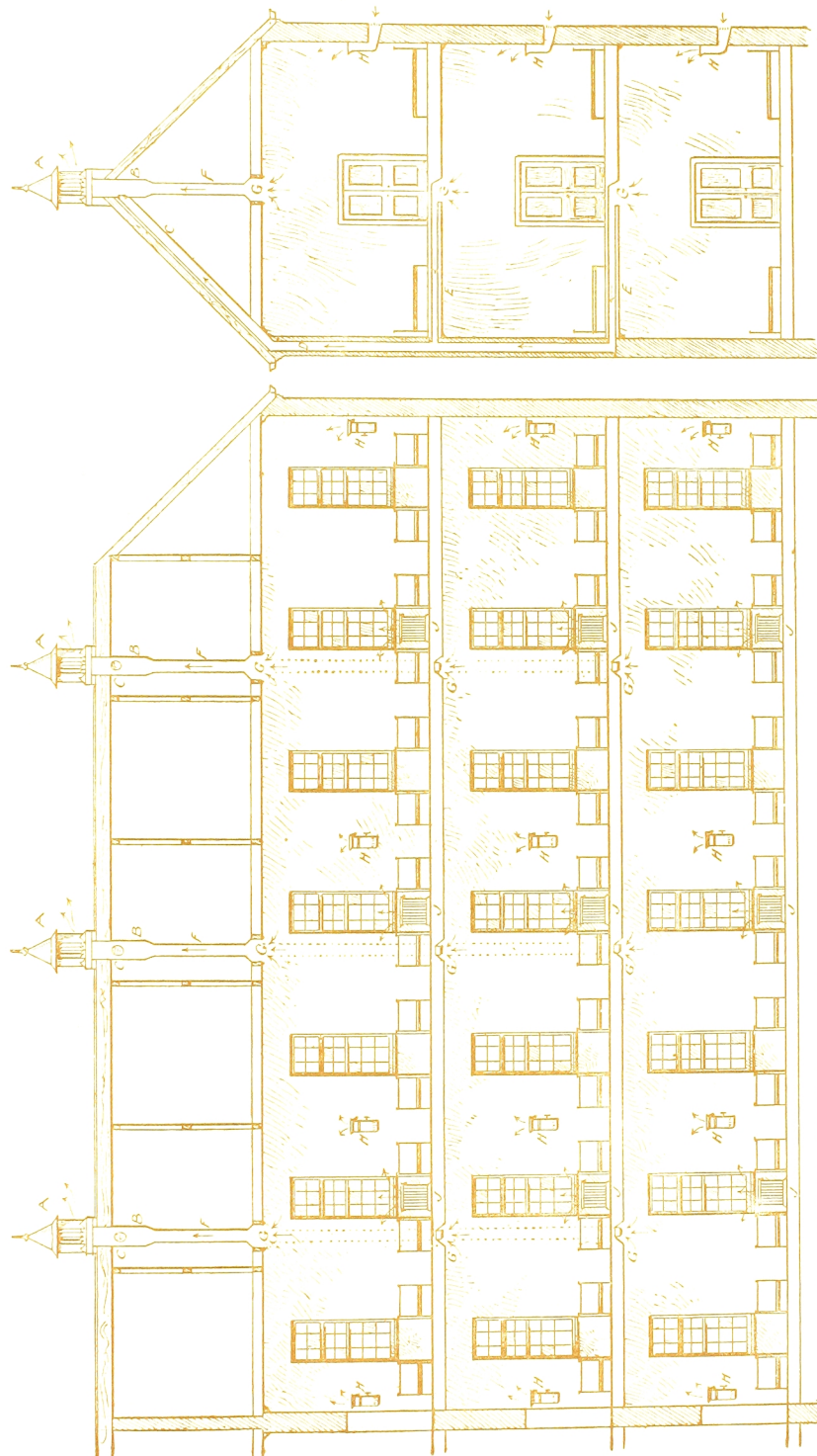
REVERSE SECTION SHEWING ADMISSION OF FRESH AIR
AT REAR OF STALLS.

ROBERT BOYLE & SON, LTD.
Ventilating Engineers,
LONDON & GLASGOW.

"You will be glad to hear that after the experience of some months your 'Air-Pump' Ventilators are most satisfactory, and are as efficient as you represent them to be."—A. DUPONT, Military Riding Academy, Brighton.

N.B.—For table of sizes and number of ventilators required for the ventilation of Stables, see pages 148, 149.

THE "BOYLE" SYSTEM OF VENTILATION As applied to BARRACKS.



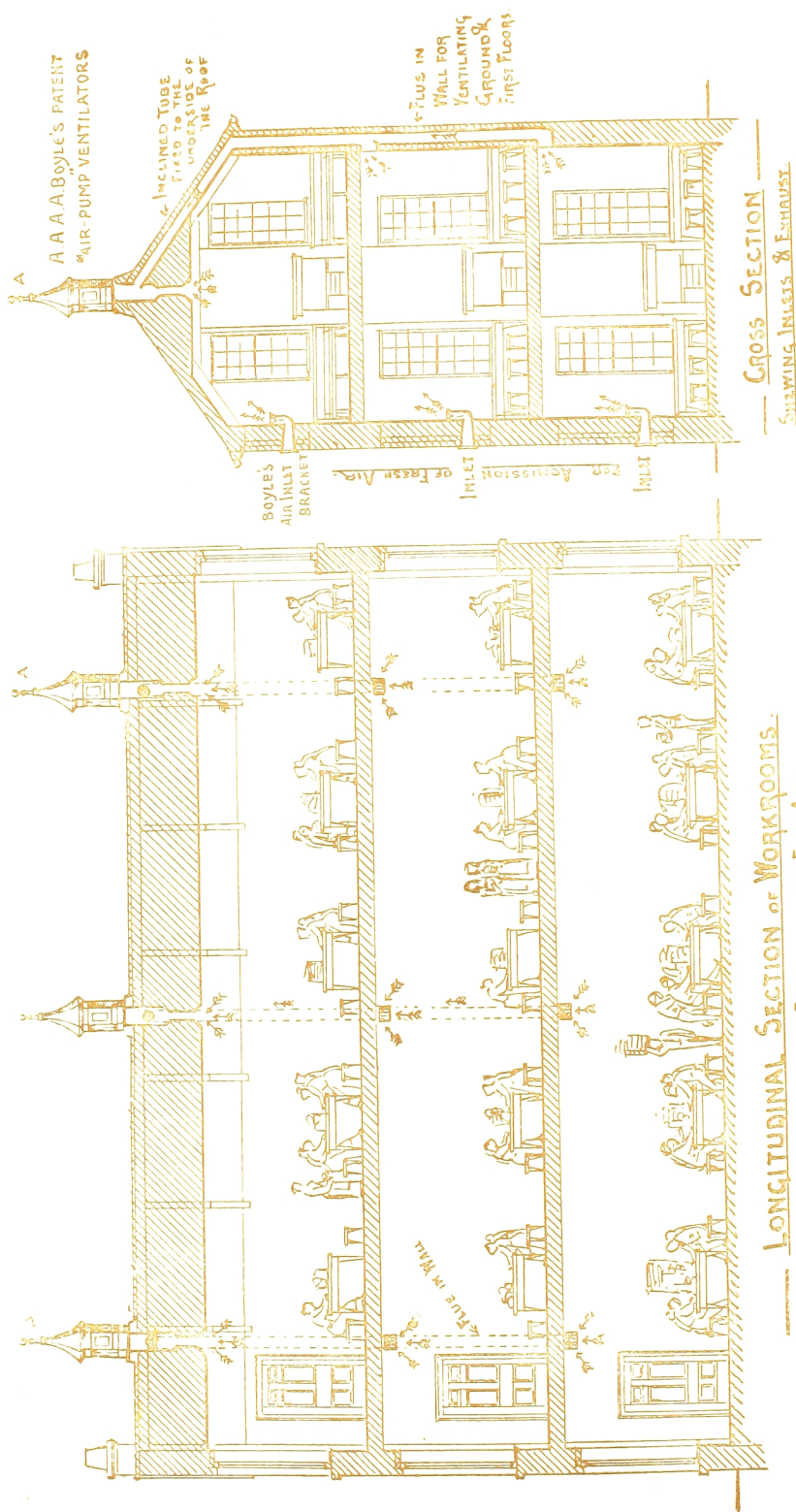
A.A. Boyle's Patent 'Air-Pump' Ventilators
 B.B. Main Extraction Shafts
 C.C. Branch Extraction Shafts connected with Upcast Flues D.D. constructed in walls
 E.E. Extraction Shafts led from Upcast Flues to foul air exit openings G.G. in centre of ceilings
 F.F. Branch Extraction Shafts connected with foul air exit openings in centre of ceilings in top floor
 H.H. Boyle's Air Inlet Brackets, for admitting screened and purified air
 J.J. Boyle's Ventilating Radiators admitting warmed, screened, and purified Air.

Note:
 All the Air Inlets are fitted with Regulating Valves, controlling the fresh air supply, which passes direct from the outer air, into the building.

R⁹T BOYLE & SON, L^{TD}
 Ventilating Engineers
 LONDON & GLASGOW

"I have the liveliest satisfaction in informing you that Boyle's 'Air-Pump' Ventilators which I erected in the Reina Cristina Barracks, Madrid, built under my direction, are working to perfection, and are giving results which we were justified in anticipating from the excellence of the system. During the whole time they have been in use they have never been found to vary in their action." —
 Lieut.-Colonel ANDRES REFALLES, Madrid.

THE "BOYLE" SYSTEM OF VENTILATION As applied to WORKROOMS.



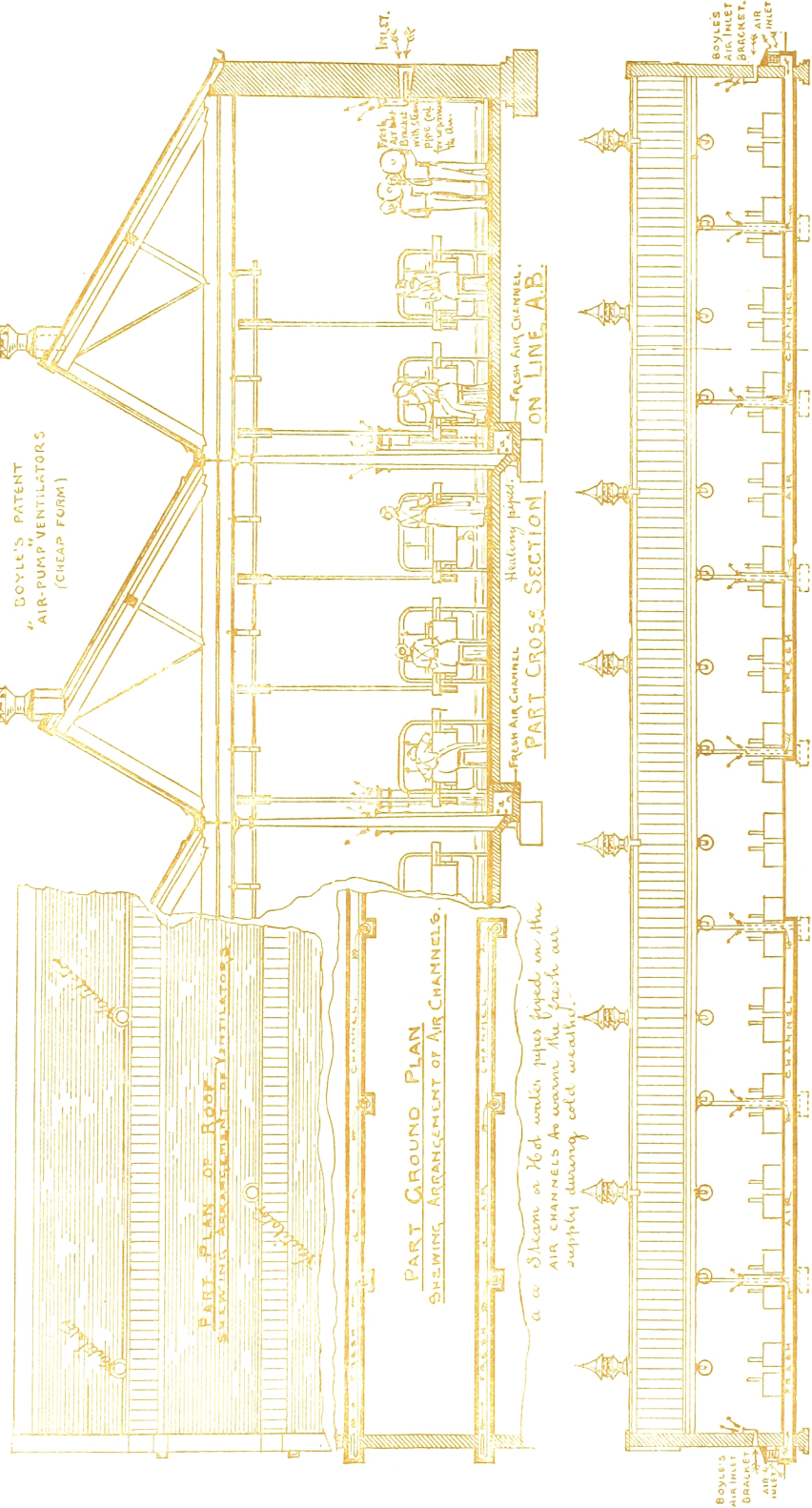
ROBERT BOYLE & SON, LTD.
Ventilating Engineers,
LONDON & GLASGOW.

"The 'Air-Pump' Ventilators which we had from you last year have given every satisfaction, and we are pleased to bear testimony to their efficiency."
—EDWIN RICHARDS & SONS, Wednesbury.

N.B.—For table of sizes and number of ventilators required for the ventilation of Workrooms, see pages 148, 149.

THE "BOYLE" SYSTEM OF VENTILATION

As applied to a WEAVING SHED.



LONGITUDINAL SECTION OF ONE BAY OF A WEAVING SHED—SHOWING THE "BOYLE" SYSTEM OF VENTILATION AND METHOD OF WARMING THE FRESH AIR SUPPLY.

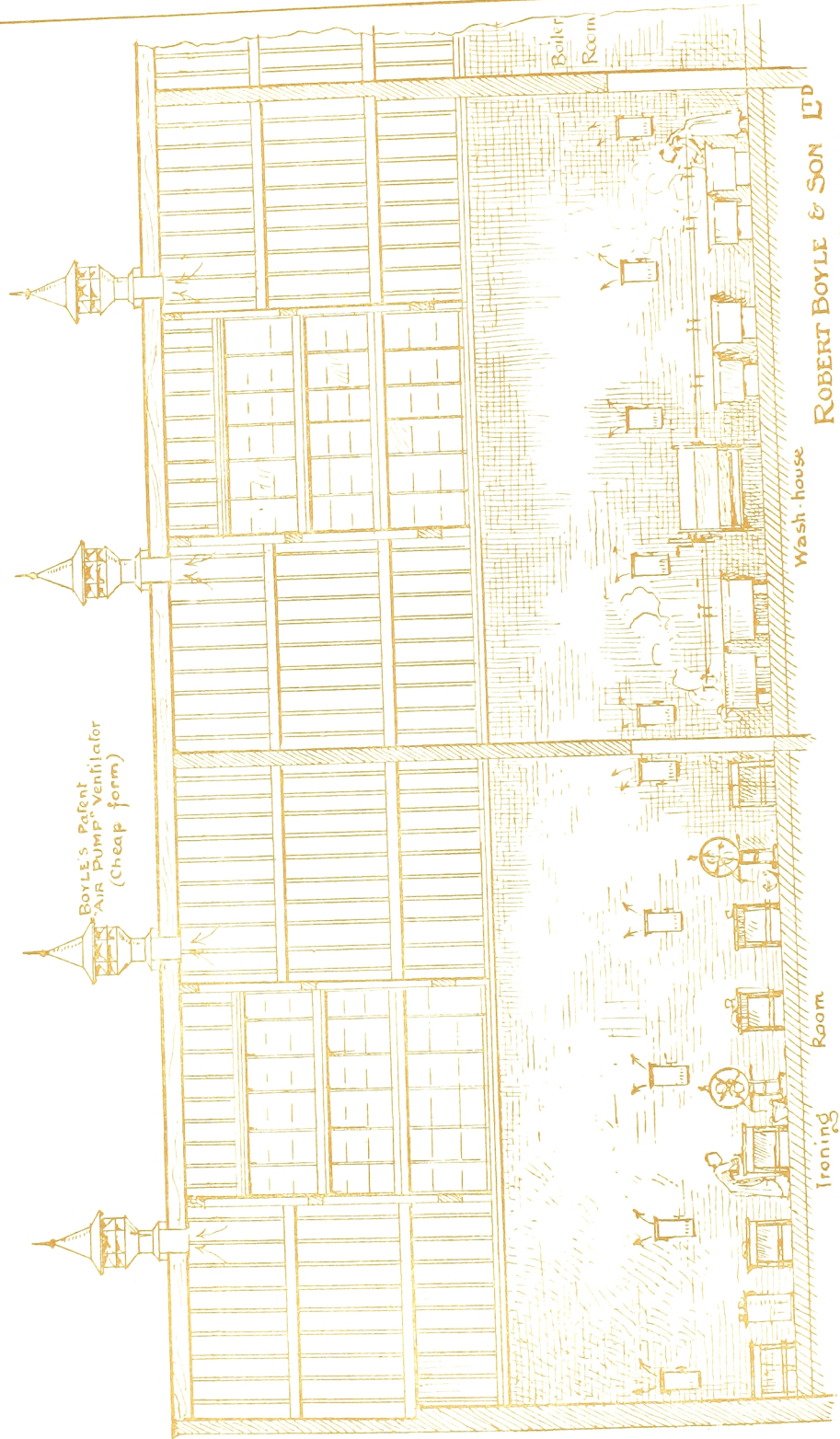
ROBERT BOYLE & SON, LTD.
Ventilating Engineers,
LONDON & GLASGOW.

"Mr. Boyle's complete success in securing the required continuous upward impulse is testified to by high authorities."—Extract from Report by H.M. CHIEF INSPECTOR OF FACTORIES, presented to both Houses of Parliament, with Drawings of the "Air-Pump" Ventilator.

N.B.—For table of sizes and number of ventilators required for the ventilation of Weaving Sheds, see pages 148, 149.

THE BOYLE SYSTEM OF VENTILATION

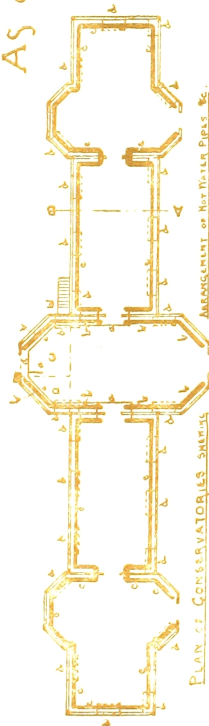
As applied to a LAUNDRY



"The efficient ventilation of Laundries is not only necessary for the health and comfort of the workers, but it is also desirable on the score of economy, for where pure air is breathed more and better work is done." — VENTILATION.

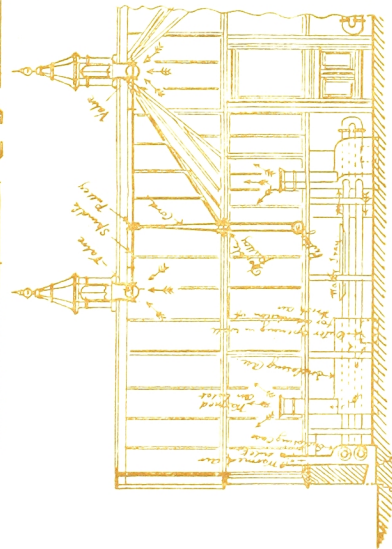
THE "BOYLE" SYSTEM OF VENTILATION

As applied to CONSERVATORIES.

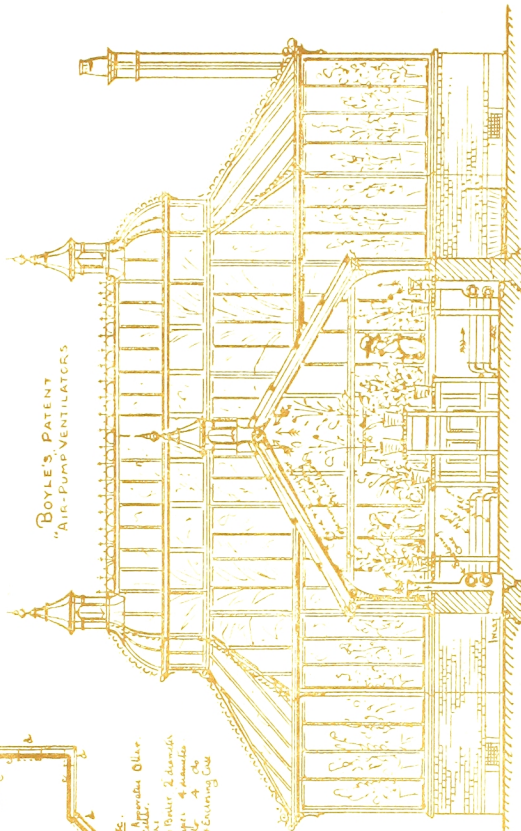


PLAN OF CONSERVATORIES SHOWING

ARRANGEMENT OF HOT WATER PIPES, &c.
 C Position of Heating Apparatus Office
 B Stove Room & Kitchen
 A Room proper for the Boiler & Condenser
 D Double System of Pipes & Condenser
 E Position of Pipes & Condenser
 F Hot Water Tank & Condenser

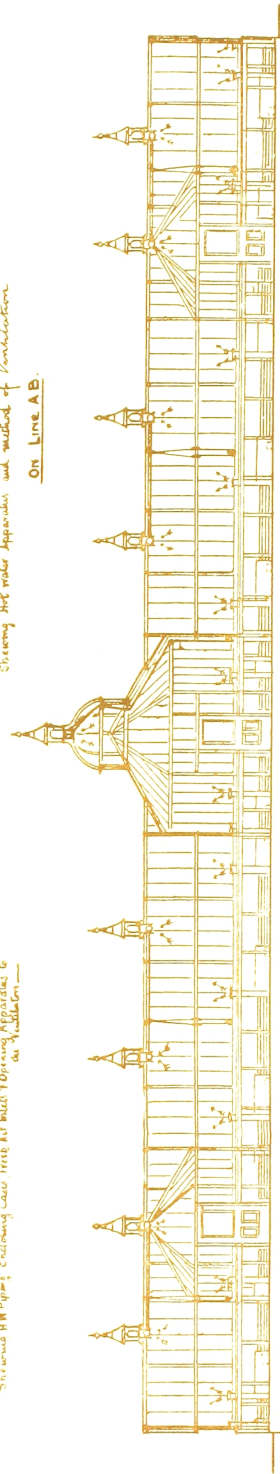


PART LONGITUDINAL SECTION . . . END HOUSE
 Showing Hot Water Pipes, &c. and the position of the Heating Apparatus, &c.



SECTION OF INTERMEDIATE HOUSE & ELEVATION OF CENTRAL HOUSE
 Showing the water apparatus and method of ventilation

On Line A.B.

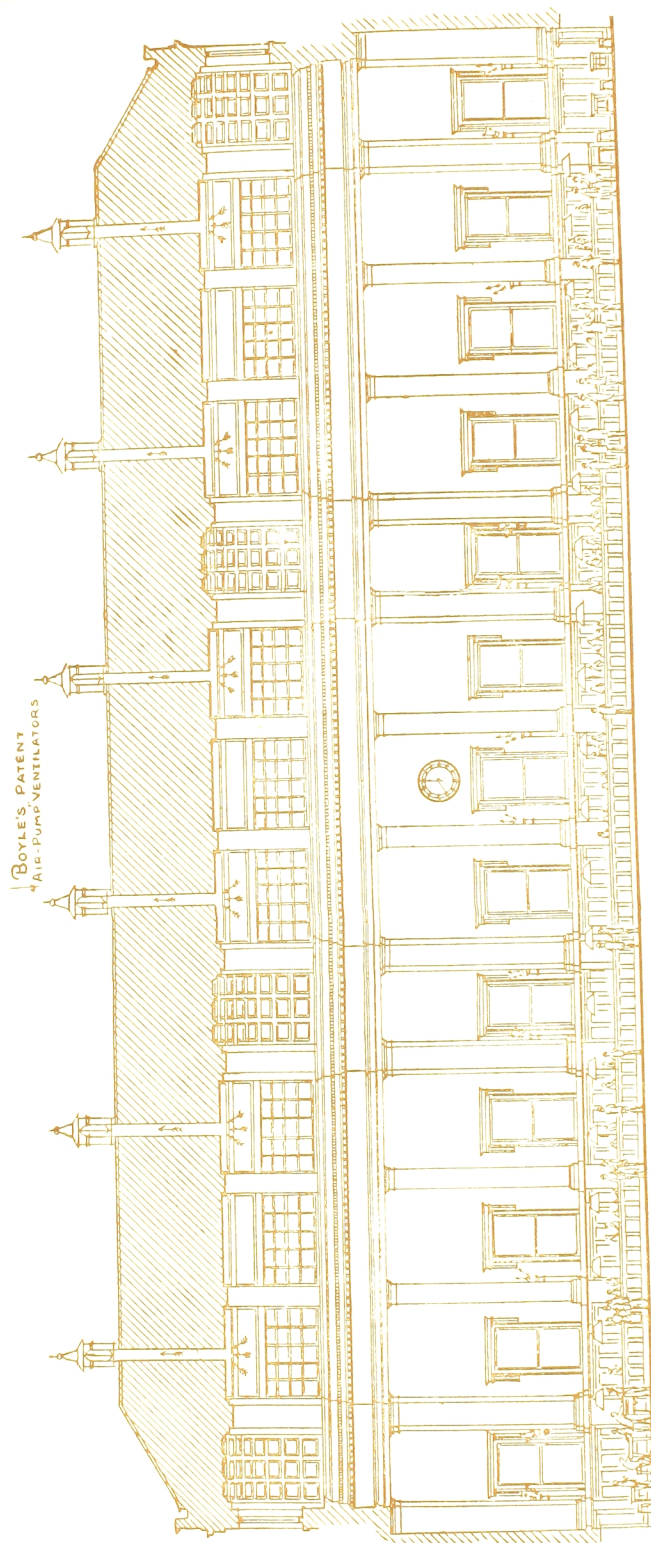


LONGITUDINAL SECTION OF CONSERVATORIES . . . SHOWING METHOD OF VENTILATION AND WARMING

ROBERT BOYLE & SON, LTD.
 Ventilating Engineers,
 LONDON & GLASGOW.

"Messrs. Boyle are to be congratulated upon having successfully grappled with a grave difficulty, which had almost become a public scandal."—*Civilian*, the accredited organ of the Civil Service.

"THE BOYLE SYSTEM OF VENTILATION" As applied to The "Long Room"—LONDON CUSTOM HOUSE.



—THE "LONG ROOM"—LONDON CUSTOM HOUSE—

ROBERT BOYLE & SON, LTD.
Ventilating Engineers
LONDON & GLASGOW.

"I have to inform you that I have conferred with the other members of the Long Room Ventilation Committee, and to state that we are unanimously of the opinion that your ventilation appliances have been a success. It is evident that no system of ventilation in so large a space as the Long Room can be rendered so perfect as to suit all idiosyncrasies and temperaments, but I confidently assert that we have enjoyed, since your appliances have been in action, a purity and clearness of atmosphere to which we had long been strangers."—H. HANCOCK HOOPER, Esq., *Chairman*, Long Room Ventilation Committee, H.M. Customs, London.

Experiments at the London Custom House

WITH THE

"Boyle" System of Ventilation.

"The experiments seem to have demonstrated the perfect success of Messrs. Boyle's work."—BUILDER.

"The Long Room of the London Custom House—one of the largest rooms in the world—has recently been ventilated by Messrs. Robert Boyle & Son, Ventilating Engineers, of London and Glasgow, under the direction of Her Majesty's Office of Works. The system applied by them is a combination of their well-known 'Air-Pump' Ventilators and vertical tube air inlets. As the Long Room of the Custom House has long been notorious for being one of the worst ventilated rooms in London, and was so officially reported to be by Professor Faraday and Dr. Ure so far back as thirty years ago, considerable interest has been displayed amongst those skilled in sanitary science as to the result of Messrs. Boyle's efforts to remedy the evil. Accordingly, on the completion of the work, a series of experiments were instituted to test the efficiency of the system. A large number of scientists and others attended those experiments. The Long Room is 194 ft. in length, 60 ft. wide, and 54 ft. in height, and is lighted by about 200 large Argand burners fixed at about the level of the head. When the gas was lighted, owing to the position of these burners, the heat and sulphurous vapour were intolerable, and a source of great discomfort and injury to the occupants of the room. The heating arrangements consisted of two large double open stove fires placed in the centre of the room. The number of clerks employed in the room is about 140, with a constant influx of the public having business with the department. Messrs. Boyle have fixed six 3-ft. diameter 'Air-Pump' Ventilators on the roof, which are connected with the interior of the room by means of iron shafts 18-in. diameter, led down to openings in the centre of the ceiling of the same diameter as the pipes. These shafts equally divide the ceiling. For the admission of air there are twelve vertical tubes, each 10-in. by 8-in., placed in the bays of six of the windows on the south side of the room, and communicating with the outer air through openings 2 feet by 1 foot, cut in the wall under the centre of each window. During the tests, the 'Air-Pump' Ventilators were found to be extracting an average of about 400,000 cubic feet of air per hour.

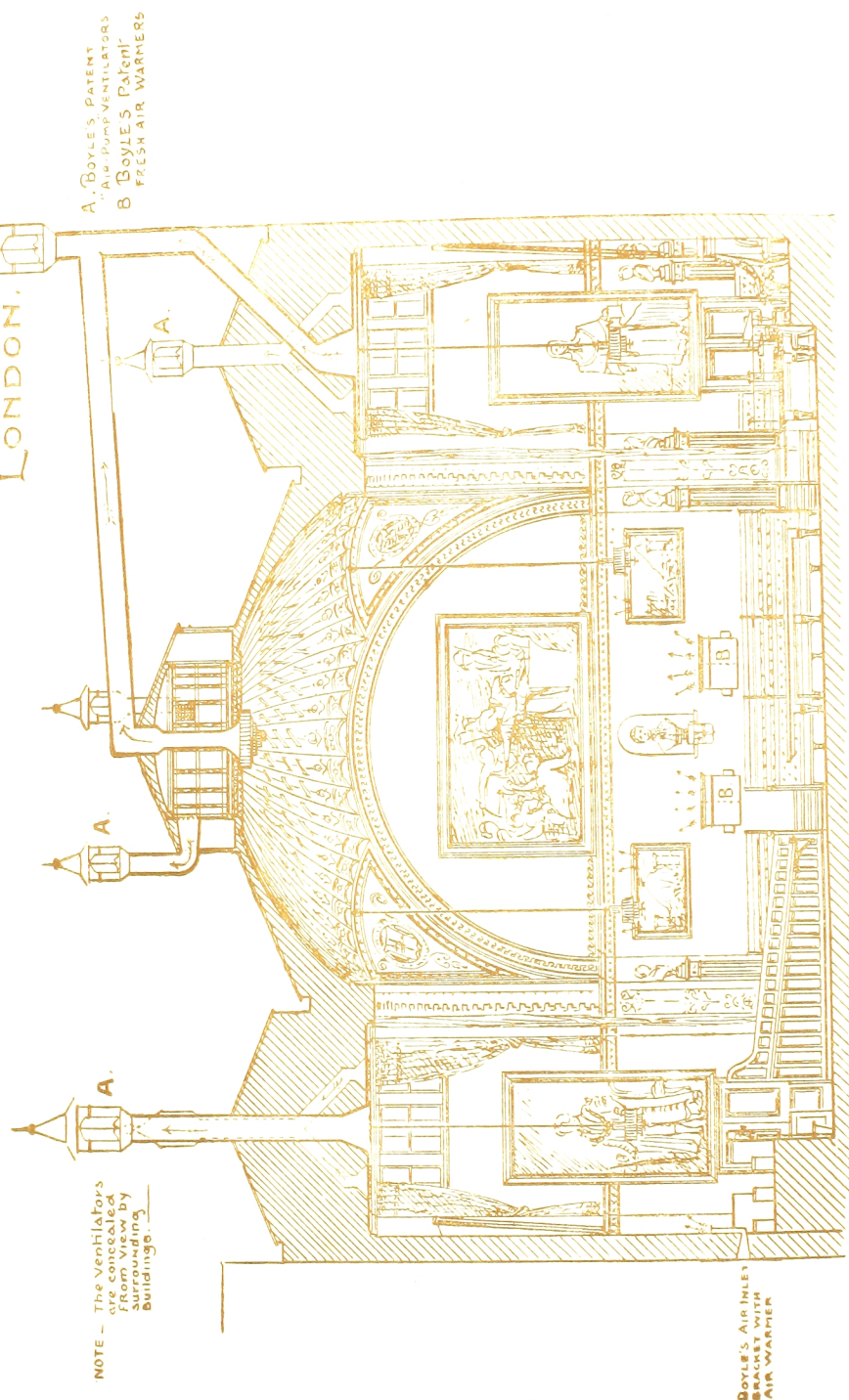
"It is interesting to notice that, when a dense fog prevailed outside, the atmosphere of the Long Room remained quite clear, and continued so throughout the day. During the whole of the experiments there was not the slightest down-draught discernible in the 'Air-Pump' Ventilators, even when all the inlets were closed. All those present at the experiments expressed themselves highly satisfied with the results obtained. The 'Air-Pump' Ventilators have in this instance been put to a series of the most severe and searching tests by men the best qualified for such work in this country, and they have undoubtedly

maintained, in the most satisfactory and conclusive manner, the high reputation they have long enjoyed as the most efficient foul-air extractors in existence. They have also been so tested under conditions more than usually unfavourable for their action, viz., in the middle of winter, with a frosty external atmosphere, and at a time when most so-called self-acting ventilators are usually closed up, to prevent the down-draught they would otherwise admit, as was notoriously the case in this very room under the old ventilating régime. With regard to the improvement which the introduction of Messrs. Boyle's system has effected in the atmosphere of the room, those occupying it testify to in the most marked manner—one gentleman, who has been for over thirty-four years engaged in the room, stating that, compared with the past, the present condition of the room was as heaven to the nether regions. Before Messrs. Boyle's system was applied there used to be a perpetual haze or cloud hanging below the ceiling. This has since entirely disappeared. In foretime, when a fog got into the room, it was several days before it found its way out, even though windows and doors were kept open. On entering the room on Monday morning, after the dense fog of Sunday, the air was found to be perfectly clear, not a trace of fog being discernible. A number of clerks engaged in the room informed us that, under the old arrangement, before the day was half over, they suffered from severe headaches and general prostration caused by the vitiated atmosphere, but since the application of Messrs. Boyle's system they felt almost as fresh when they left in the evening as when they came in the morning, and that they do not now suffer from headaches is certainly a most convincing proof of the efficiency of the ventilation. Sea captains, we are informed, visiting the room, used to complain loudly of the foul state of the atmosphere in which they transacted their business, and now we are given to understand they speak as strongly in favour of the improvement which has been effected. Messrs. Robert Boyle & Son are to be congratulated upon the success they have achieved, and the London Custom House may proudly be added to the long list of public buildings successfully ventilated by them, and which bear testimony to the soundness of the principle they advocate. As founders of the profession of ventilating engineers, they have raised the subject to the dignity of a science, and brought their system to such a state of perfection that we understand they are prepared to guarantee the efficient ventilation of any building entrusted into their hands, no matter how many other systems may have been previously tried and found unsuccessful."—*Industry*.

"Being aware, from personal experience, of the bad state of the atmosphere which used to prevail on Court days, we are in a position to say that a marked improvement has been effected—so decided a change for the better, in fact, that we can quite endorse the favourable opinion of it which has been given by Sir John Monckton, the Town Clerk."—*Builder*.

THE "BOYLE" SYSTEM OF VENTILATION

As applied to The COUNCIL CHAMBER, GUILDHALL, LONDON.



—THE COUNCIL CHAMBER—GUILDHALL—LONDON—

ROBERT BOYLE & SON, LTD.
Ventilating Engineers,
LONDON & GLASGOW.

"I am asked by Messrs. Boyle & Son to state my personal experience of the recent ventilation of the Council Chamber. I can do so in a very few words. Until the present year I never knew what it was to leave the Guildhall on a 'Common Council day' without a headache. I now do not know what a headache is. In fact the palpable alteration for the better in the atmosphere, even on crowded days, is very satisfactory, and it appears to me—a non-expert—that Messrs. Boyle's system is eminently valuable and practicable."—Sir JOHN MONCKTON,
Town Clerk, London

Ventilation of the Council Chamber, Guildhall, London, WITH THE “Boyle” System of Ventilation.*

“We can quite endorse the favourable opinion of it which has been given by Sir John Monckton, the Town Clerk.”—BUILDER.

ANY ordinary observer who has had the privilege of entering the Council Chamber of the Guildhall, London, even when devoid of occupants, would be almost sure to ask himself the question as to how the room was ventilated. It is one of those apartments that appears to strike the mind that a something more than can be seen is necessary for the healthful comfort of those whose civic duties compel them to pass a portion of their time in it, and if the stranger has had an opportunity of being present when the City parliament have been holding their debates, he would have soon found that the atmosphere was anything but inviting; and had he asked any of the officials, or even the members of the Council themselves, he would have heard dissatisfaction expressed on all hands, for it is notorious that, in spite of different attempts to remedy it, including what we may term an elaborate system introduced no later than three years since, the room in which the City Fathers hold their conclaves has been one of the worst ventilated apartments, for its size, in the metropolis. We say ‘has been,’ for a new system of ventilation has recently been completed that promises to surpass all previous attempts to introduce fresh air and exhaust the vitiated, and one that after many severe tests has received the approbation of all concerned in the carrying out of the plan. Smarting under the annoyances they had long laboured under, the City Architect, by the direction of the Corporation of London, requested Messrs. Robert Boyle & Son, of Holborn Viaduct and Glasgow, whose success as ventilating engineers has become matter of world-wide notoriety, to submit to him a system of ventilation adapted to the requirements of the Chamber, but on the condition that it would only be accepted after exhaustive trials had proved to the City Architect and a committee that it was

successful; and if not to their satisfaction, every vestige of it was to be removed within a specified time, and everything made good at Messrs. Boyle’s expense.

Thus the contract was entered upon on the principle of ‘no cure, no pay.’ Confident in their system, the firm accepted the terms, and the guarantee, which was of a very stringent character, was drawn up by the Corporation, and was of such a nature as would put Messrs. Boyle’s system to a most severe and crucial test. In January last the Chamber was handed over to them to commence operations, and as we have carefully watched the progress of the work, and were present only a few days since—it now having passed through the ordeals prepared for it—we have much pleasure in adding our testimony to its satisfactory results. It has received the approbation of the City Architect, the committee, and, we may add, of the public. Messrs. Boyle have had the privilege accorded them of inviting as many as they pleased to witness the results, and a large number of invitations were issued by them, in which they included those gentlemen they considered interested in the question of ventilation, and competent to pass an opinion upon the work, and also competitors in their own profession, advocates of totally different systems. Amongst those who accepted the invitation were Dr. C. W. Siemens, F.R.S.; Captain Douglas Galton, C.B., F.R.S.; Professor Corfield, London University College; Captain McHardie, R.E., Home Office; Dr. Steele, Guy’s Hospital; Mr. Ernest Hart; Major-General F. C. Cotton, R.E.; Mr. A. Billing, Surveyor to Guy’s Hospital and St. Olave’s Board of Works; Mr. H. Currey, Surveyor to St. Thomas’s Hospital; Mr. Alexander Graham, F.R.I.B.A.; Dr. Sedgwick Saunders, Medical Officer of Health to the City of London; Dr. Lavies, Medical Officer of Health for Westminster; Mr. Thornhill,

* For results of mechanical ventilation of a Council Chamber by electric fan extraction, see pages 24, 25.

Surveyor to the London Hospital; Mr. W. Butterfield, Architect; Mr. E. J. Hansom, F.R.I.B.A.; Mr. E. F. Griffith, C.E.; Mr. C. W. Pugin, Architect; and Mr. G. A. Bruce, C.E.; besides numerous other Architects, Civil Engineers, and Medical Men.

"The application of the system adopted may be described as follows:—Nine of Messrs. Boyle's Patent Self-Acting 'Air-Pump' Ventilators are fixed on the top of iron shafts, standing at various heights above the roof, to clear them of obstruction. Four of these shafts, viz., two at each end of the Chamber, are 13-inch diameter, branching off a little above the ceiling into two 10-inch pipes, communicating with openings in the ceiling 2 feet in diameter, concealed by means of ornamental centre flowers, or ceiling plates. On the top of each shaft is fixed a 2-feet 'Air-Pump' ventilator. At the east end of the Chamber a shaft 18 inches in diameter is carried through the roof, having a 30-inch ventilator on its top. This shaft expands at the bottom to 2 feet 6 inches by 2 feet 3 inches, covering an opening of the same dimensions in the ceiling. At the west end, a shaft of 30½ inches by 20½ is brought into requisition, and is carried up a considerable height to the top of an adjoining building, surmounted with a 3-feet ventilator. A shaft 16 inches diameter, that is connected with the large "sunlight" gas-burner in the lantern over the central dome of the Chamber, is also run into this shaft, the ventilation of the body of the room being partially effected by this means. On the top of the outer casing of the lantern three 13-inch shafts are fixed at equidistant spaces, and crowned with 20-inch ventilators, the shafts communicating with openings in the interior of the lantern by means of expanded iron hoppers. These complete the arrangements for the extraction of the vitiated air from the Chamber. It may be mentioned *en passant* that a portion of these shafts formed part of the old system of so-called ventilation, and were then surmounted with revolving cowls.

"For the supply of fresh air to the Chamber Messrs. Boyle have turned to account, with certain alterations, some of the modes of ingress they found existing when the work was entrusted to them, and that were then of but little use. On the south side of the Chamber four vertical air tubes or brackets are fixed against the walls, two of these being 2 feet by 2½ inches by 3 feet, the other two, which are placed a little higher up the wall, measuring 18 inches by 4 inches by 2 feet. The tubes communicate direct with the outer atmosphere by holes cut through the walls and covered with

cast-iron gratings. The air inlets are fitted with Messrs. Boyle's patent heaters, which are now so generally known amongst the profession as to render description here unnecessary. These are, of course, added for the purpose of warming the incoming air to any temperature required as it enters the building. The north wall is similarly treated, with the addition of an extra tube at the end by the Lord Mayor's seat. At the public end of the Chamber three more inlet tubes are fixed, similarly fitted with the air warmers, while others, amounting in the aggregate to sixteen, are fixed in other positions, completing the arrangements for the fresh air supply. We may add that an abundant quantity is admitted, and the tests have shown that the air can be warmed in cold weather to a temperature of from 60 deg. to 120 deg., thus entirely preventing cold draughts, the usual attendant on most methods of admitting cold air to a building where provision is not made for warming it.

"Referring to the extraction of the vitiated air, it is not necessary to give the full table of results from January until the present time; we need only say that the average quantity withdrawn amounted to 500,000 cubic feet per hour, and that during the whole of the experiments, official and otherwise, not the slightest down-draught was experienced: had it been otherwise the conditions would not have been fulfilled, and the firm would have been called upon to remove their appliances, and their system would have been pronounced a failure, one of the principal conditions being that down-draughts should be entirely absent, and that a continuous and powerful up-draught should be maintained.

"Previous to Messrs. Boyle undertaking this work great complaints had been made with respect to the draught always present in the Chamber, but since the completion of their arrangements lighted candles have been placed in various parts of the room, the flame has been watched, and it has been clearly demonstrated that they were in all instances perfectly steady, showing that the draughts had ceased to exist.

"After six months' practical experience, Mr. Horace Jones, City Architect, and President of the Royal Institute of British Architects, has certified that all the conditions have been fulfilled, and that the ventilation is successful; and, as we before observed, this has been endorsed by the committee, and Messrs. Boyle have received their account. Thus another public building has been added to the long list of those that the firm have successfully ventilated.

"The following report has been received by Messrs. Boyle from Sir John Monckton, the Town Clerk:—

"GUILDHALL, E.C.

"I am asked by Messrs. Boyle & Son to state my personal experience of the recent ventilation of the Council Chamber. I can do so in a very few words. Until the present year I never knew what it was to leave the Guildhall on a 'Common Council day' without a headache. I now do not know what a headache is. In fact the palpable alteration for the better in the atmosphere, even on crowded days, is very satisfactory, and it appears to me—a non-expert—that Messrs. Boyle's system is eminently valuable and practicable."

"In addition, the officials of the Court and many members of the Council have personally thanked Messrs. Boyle for the benefits they have derived, from a healthful point of view, from the application of the system. From a large number of equally favourable letters received by the firm from independent sources, we abstract the following received from an eminent London physician and sanitarian. (Dr. P. CHATTERTON, late House Physician, Hôtel Dieu, Paris):—'After thoroughly testing and examining your system of ventilation as applied to the Council Chamber of the Guildhall, I have great pleasure in being able to say that I am in every way satisfied with the result. It is, in my estimation, the most perfect system yet introduced, and I greatly doubt there being any room for improvement upon it. The fact of your appliances being entirely self-acting and having no movable parts liable to get out of order after having been placed, is a great boon, as it renders any after cost or attention unnecessary. During the time that I have devoted to testing your appliances I have always found them entirely free from down-draught, a feature I have not found in any other system, and which I opine to be of the greatest advan-

tage, as it not only serves to ventilate the building more thoroughly, but furthermore maintains an even temperature therein, which no sudden change of weather can affect. My pursuits have rendered me practically acquainted with many systems of ventilation now in use, both automatic and otherwise, and after careful examination I have arrived at the conclusion that your system is not only the simplest but the most efficacious I have yet met with. This opinion is, in so far as the Council Chamber is concerned, also shared by some friends of mine who are members of the Council, and who pronounce the application of your process simply faultless.'"—*Architect*.

"We have had an opportunity of being present in the Chamber during a meeting of the Common Council, and being aware, from personal experience, of the bad state of the atmosphere which used to prevail on Court days, we are in a position to say that a marked improvement has been effected—so decided a change for the better, in fact, that we can quite endorse the favourable opinion of it which has been given by Sir John Monckton the Town Clerk."—*Builder*.

"We have witnessed the operation of the system, and can now speak from personal experience of the merits of the principle which Messrs. Boyle have applied to this and other public buildings in London and the provinces. . . . Messrs. Boyle & Son's system is extremely simple, and may be described to be the application of means by which the natural laws of ventilation can be effectively brought into operation. . . . Our examination of the up-draught in the shafts has shown the efficiency of the ventilators."—*Building News*.



Names of a few of the Royalty and Nobility who have been supplied with the "Boyle" System of Ventilation, and "Air-Pump" Ventilators.

Her Majesty the Queen.
His Imperial Majesty the Emperor of Germany.
His Imperial Majesty the Czar of Russia.
His Imperial Majesty the Emperor of Austria.
His Majesty the King of Italy.
His Majesty the King of Spain.
His Majesty the King of Portugal.
His Majesty the King of Norway and Sweden.
His Majesty the King of Denmark.
Her Majesty the Queen of Holland.
His Royal Highness the Prince of Wales.
His Royal Highness the Duke of Edinburgh.
His Royal Highness the Duke of Connaught.
His Royal Highness the Duke of Albany.
His Royal Highness the Duke of York.
His Royal Highness the Duke of Cambridge.
His Grace the Archbishop of Canterbury.
His Grace the Archbishop of York.
The Right Reverend the Lord Bishop of London.
The Right Reverend the Lord Bishop of Gloucester and Bristol.
His Grace the Duke of Argyll.
His Grace the Duke of Atholl.
His Grace the Duke of Beaufort.
His Grace the Duke of Buccleuch.
His Grace the Duke of Bedford.
His Grace the Duke of Cumberland.
His Grace the Duke of Devonshire.
His Grace the Duke of Fife.
His Grace the Duke of Grafton.
His Grace the Duke of Hamilton.
His Grace the Duke of Leeds.
His Grace the Duke of Marlborough.
His Grace the Duke of Norfolk.
His Grace the Duke of Northumberland.
His Grace the Duke of Portland.
His Grace the Duke of Richmond.
His Grace the Duke of Rutland.
His Grace the Duke of Somerset.
His Grace the Duke of Sutherland.
His Grace the Duke of Wellington.
His Grace the Duke of Westminster.
The Most Honourable the Marquis of Abercorn.
The Most Honourable the Marquis of Abergavenny.
The Most Honourable the Marquis of Ailsa.
The Most Honourable the Marquis of Anglesey.

The Most Honourable the Marquis of Bath.
The Most Honourable the Marquis of Breadalbane.
The Most Honourable the Marquis of Bristol.
The Most Honourable the Marquis of Bute.
The Most Honourable the Marquis of Dufferin.
The Most Honourable the Marquis of Drogheda.
The Most Honourable the Marquis of Exeter.
The Most Honourable the Marquis of Londonderry.
The Most Honourable the Marquis of Lansdowne.
The Most Honourable the Marquis of Lothian.
The Most Honourable the Marquis of Northampton.
The Most Honourable the Marquis of Ripon.
The Most Honourable the Marquis of Salisbury.
The Most Honourable the Marquis of Zetland.
The Right Honourable the Earl of Abingdon.
The Right Honourable the Earl of Aberdeen.
The Right Honourable the Earl of Albemarle.
The Right Honourable the Earl of Ashburnham.
The Right Honourable the Earl of Aylesford.
The Right Honourable the Earl Brownlow.
The Right Honourable the Earl Cairns.
The Right Honourable the Earl of Carnarvon.
The Right Honourable the Earl of Cawdor.
The Right Honourable the Earl of Coventry.
The Right Honourable the Earl Cowper.
The Right Honourable the Earl of Cranbrook.
The Right Honourable the Earl of Cleveland.
The Right Honourable the Earl of Crewe.
The Right Honourable the Earl of Derby.
The Right Honourable the Earl of Dudley.
The Right Honourable the Earl of Durham.
The Right Honourable the Earl of Ellesmere.
The Right Honourable the Earl of Eglinton.
The Right Honourable the Earl of Elphinstone.
The Right Honourable the Earl of Granville.
The Right Honourable the Earl of Glasgow.
The Right Honourable the Earl Grey.
The Right Honourable the Earl of Kimberley.
The Right Honourable the Earl of Kenmare.
The Right Honourable the Earl of Leicester.
The Right Honourable the Earl of Leitrim.
The Right Honourable the Earl of Macclesfield.
The Right Honourable the Earl of Mar and Kellie.

The Right Honourable the Earl of Morton.
The Right Honourable the Earl of Mount-Edgumbe.
The Right Honourable the Earl of Northbrook.
The Right Honourable the Earl of Pembroke.
The Right Honourable the Earl of Radnor.
The Right Honourable the Earl of Rosebery.
The Right Honourable the Earl of Shrewsbury.
The Right Honourable the Earl Spencer.
The Right Honourable the Earl of Sefton.
The Right Honourable the Earl of Stair.
The Right Honourable the Earl of Strathford.
The Right Honourable the Earl of Warwick.
The Right Honourable the Earl of Wharfedale.
The Right Honourable the Earl of Zetland.
The Right Honourable Viscount Exmouth.
The Right Honourable Viscount Boyne.
The Right Honourable Viscount Falmouth.
The Right Honourable Viscount Peel.
The Right Honourable Lord Amptill.
The Right Honourable Lord Armstrong.
The Right Honourable Lord Abinger.
The Right Honourable Lord Arundell.
The Right Honourable Lord Ashbourne.
The Right Honourable Lord Bagot.
The Right Honourable Lord Battersea.
The Right Honourable Lord Boyle.
The Right Honourable Lord Brassey.
The Right Honourable Lord Burton.
The Right Honourable Lord Chelmsford.
The Right Honourable Lord Carrington.
The Right Honourable Lord Churston.
The Right Honourable Lord Cromer.
The Right Honourable Lord Delamere.
The Right Honourable Lord Dorchester.
The Right Honourable Lord Elgin.
The Right Honourable Lord Francis Hervey.
The Right Honourable Lord Kelvin.
The Right Honourable Lord Kenmare.
The Right Honourable Lord Kinnaird.
The Right Honourable Lord Leconfield.
The Right Honourable Lord Rothschild.
The Right Honourable Lord Sefton.
The Right Honourable Lord Revelstoke.
The Right Honourable Lord Wantage.
The Right Honourable Lord Wolverton, &c., &c.

Names of a few of the Public Buildings in the United Kingdom to
which the "Boyle" System of Ventilation and "Air-Pump"
Ventilators have been applied.

Windsor Castle.		New Medical Schools	London.	Sandringham.
Osborne "		Westminster "	"	Claremont.
Balmoral "		Christ's Hospital (Blue Coat School, "	"	Royal Exchange, Glasgow.
Buckingham Palace	London.	Brook Hospital, Shooter's Hill "	"	Stock "
St. James's "	"	Grove " Tooting "	"	Royal Arsenal, Woolwich.
Lambeth "	"	Small-pox Hospital Ship "Castalia" "	"	" Dockyard "
Marlborough House	"	St. Bartholomew's Hospital "	"	Royal William Dockyard, Plymouth.
War Office	"	London "	"	H.M. Dockyard, Portsmouth.
Admiralty	"	Guy's "	"	H.M. " Sheerness.
Horse Guards	"	Fountain "	"	H.M. " Devonport.
Government Offices, Whitehall	"	Foundling "	"	H.M. " Chatham.
Somerset House	"	German "	"	Inkerman Barracks, Woking.
South Kensington Museum	"	Greenwich "	"	Aldershot Camp " Aldershot.
National Gallery	"	Chelsea "	"	Portobello " Dublin.
The Tower	"	South-Western "	"	Curragh Camp " Curragh.
Royal Mint	"	Finchley "	"	Citadel " Dover.
British Museum	"	Royal Free "	"	Cavalry " Brighton.
Custom House	"	Lambeth Lying-In "	"	Maryhill " Glasgow.
Guildhall	"	Temperance "	"	Portobello " Edinburgh.
Mansion House	"	Great Northern Central Hospital "	"	Edinburgh Castle " Edinburgh.
Bank of England	"	West End Hospital "	"	Parkhurst " Isle of Wight.
St. Paul's Cathedral	"	Wandsworth and Clapham		Naval " Devonport.
Brompton Oratory	"	Infirmary "	"	Royal Marine " Plymouth.
Zoological Gardens	"	Greenwich Infirmary "	"	" Artillery " Sheerness.
"Lloyd's"	"	Lambeth "	"	H.M. Barracks, Ipswich.
Inner Temple Library	"	City of London "	"	" " Portsmouth.
Council Chamber, Royal Institute of		Kensington "	"	Shorncliffe Camp.
British Architects	"	St. George's Workhouse		H.M. Prison, Portland.
Royal College of Music	"	Wandsworth "	"	" " Broadmoor.
Guildhall School of Music	"	Lambeth "	"	" " Dartmoor.
Council Chamber, Royal Agricultural		Poplar "	"	" " Manchester.
Society of England	"	Camberwell "	"	" " Portsmouth.
Agricultural Hall	"	West Ham "	"	" " Derby.
Olympia	"	Reform Club		" " Leicester.
Royal Masonic Institution	"	Carlton Club	"	" " Glasgow.
Central Meat Markets, Smithfield	"	Athenæum Club	"	Trinity College, Cambridge.
Burlington House	"	United Service Club	"	Caius " "
People's Palace	"	St. James's Club	"	Emanuel " "
Headquarters Metropolitan Police	"	Thatched House Club	"	St. John's " "
" Honourable		Junior Athenæum Club	"	Eton " Eton.
Artillery Co.	"	Travellers' Club	"	Harrow " Harrow.
Royal Courts of Justice Chambers	"	Council Hall and Offices, Pharma-		Marlboro' " Marlboro'.
" Exchange	"	ceutical Society of Great Britain	"	Wellington " Berks.
Stock "	"	Public Library, Battersea	"	Aberdeen University, Aberdeen.
Wool "	"	" " Chelsea	"	Cambridge Hospital, Aldershot.
Coal "	"	" " Newington	"	Netley Hospital.
Corn "	"	" " Kensington	"	Royal Infirmery, Glasgow.
Regent's Park Barracks	"	" " Kensal Town	"	The Register House, Edinburgh.
Trafalgar "	"	Deaf and Dumb Asylum	"	Royal Asylum, Edinburgh.
Wellington "	"	Colney Hatch Lunatic Asylum.	"	Holloway Sanatorium, Virginia Water.
Finsbury Militia	"	Hanwell Asylum.		Corporation Galleries, Glasgow.
Knightsbridge	"	Hampton Court Palace.		Art Galleries, Birmingham, &c., &c
King's College	"	Canterbury Palace.		
Royal Naval Schools	"			

PROFESSOR SHAW

IN HIS REPORT TO THE
LOCAL GOVERNMENT
BOARD ON THE VENTI-
LATION OF POOR LAW
SCHOOLS (1897), SAYS
RE FOREST GATE SCHOOL

"Each portion has a
Boyle's Ventilator on
the ridge.... Came in
after dinner, and the
smell was not op-
pressive.... Boyle's
ventilators said to be
a great improvement
have been there nine
months."



SIR HENRY BURDETT

IN "HOSPITALS AND ASY-
LUMS OF THE WORLD"
SAYS RESPECTING THE
SMALL-POX HOSPITAL
SHIP 'CASTALIA' (WHICH
IS VENTILATED WITH
THE BOYLE SYSTEM
OF VENTILATION, SEE
PAGE 51).

"Altogether the arrange-
ments are very complete
and satisfactory."



THE "BOYLE" SYSTEM
OF
VENTILATION
AS APPLIED TO
SEWERS, DRAINS, AND SOIL PIPES.

PART IV.

"Our drains and sewers are so many death traps unless Ventilated in such a manner that all noxious air escaping from them cannot be inhaled by any one." SIR ROBERT RAWLINSON.

BALDWIN LATHAM, CE.

"As an exhausting Cowl, Boyle's 'Air-Pump' Ventilator is well adapted for fixing on the top of a soil pipe, or in any position in which exhaustion produced by an induced current is of value. The arrangement is extremely simple, and a continuous current is set up through the Ventilator"



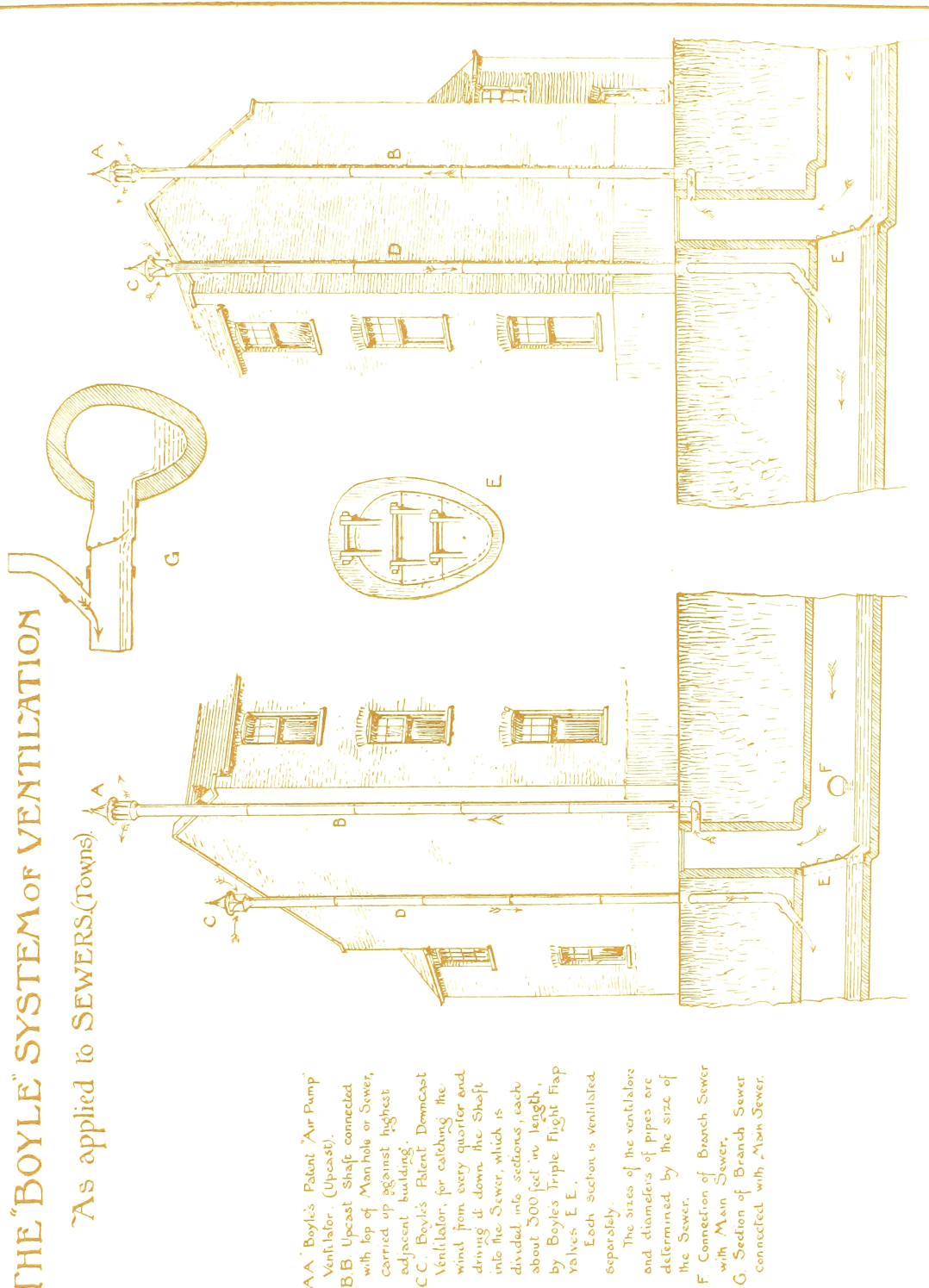
S.G. BILLINGHAM,
BOROUGH SURVEYOR
DEVIZES.

"I have the greatest satisfaction in testifying to the value of your 'Air-Pump' Ventilators. I have used them to all the Ventilation pipes that I have had erected in this Borough on all our main sewers etc. with the best results and I strongly recommend them for similar purposes."

With the "Boyle" System of Ventilation for sewers a double power is secured, viz., the aspirating force of the "Air-Pump" Ventilator which is always in action, even when there is absolutely no perceptible movement of the air, and the downward air-propelling action of the downcast ventilator; the principle being a combination of extraction and impulsion by natural means.

THE "BOYLE" SYSTEM OF VENTILATION

As applied to SEWERS (Towns).



A.A. Boyle's Patent "Air Pump" Ventilator. (Upcast).

B.B. Upcast Shaft connected with top of Manhole or Sewer, carried up against highest adjacent building.

C.C. Boyle's Patent Downcast Ventilator, for catching the wind from every quarter and driving it down the Shaft into the Sewer, which is divided into sections, each about 300 feet in length, by Boyle's Triple Flight Flap Valves E.E. Each section is ventilated separately.

The sizes of the ventilators and diameters of pipes are determined by the size of the Sewer.

F. Connection of Branch Sewer with Main Sewer.

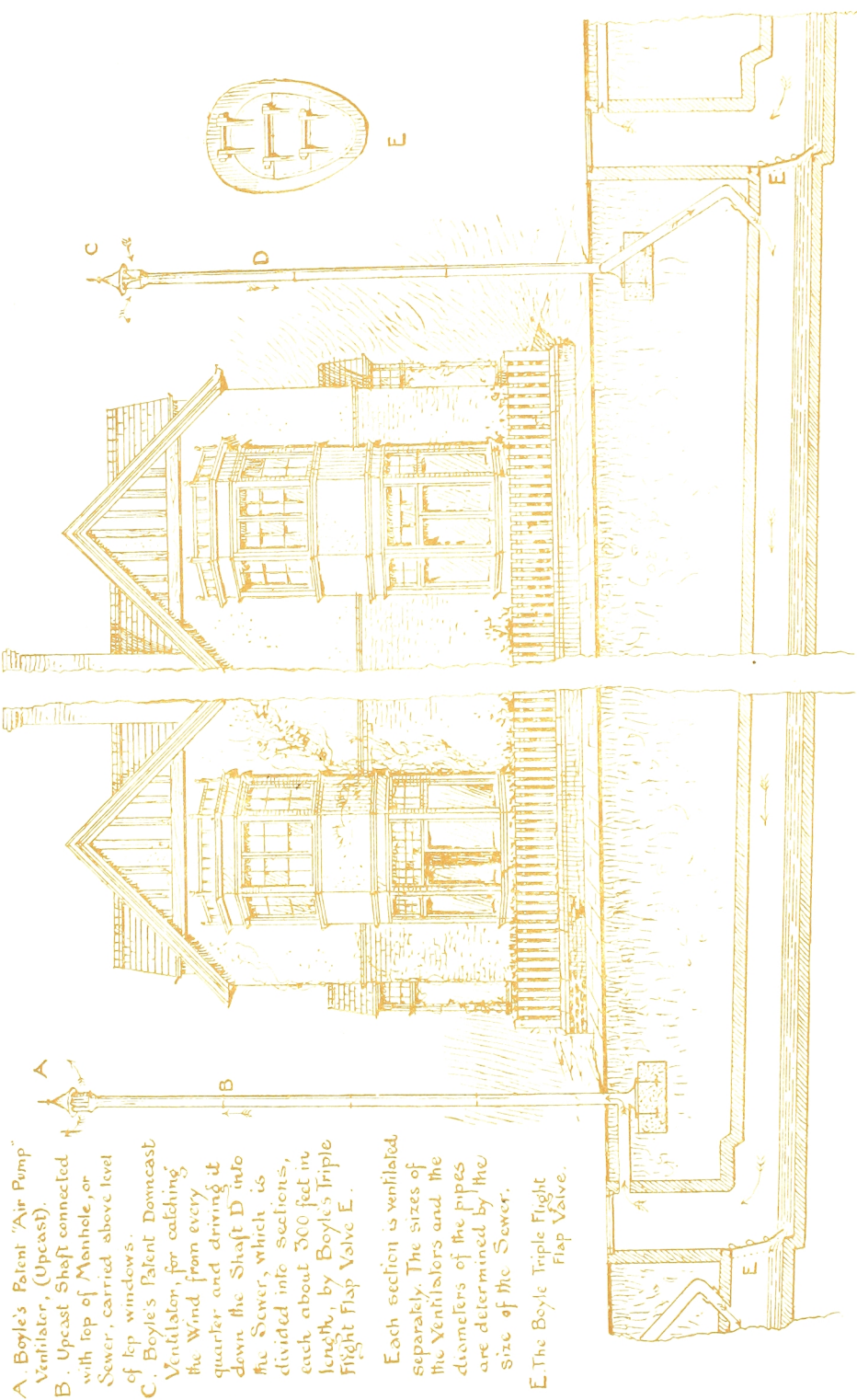
G. Section of Branch Sewer connected with Main Sewer.

The air being driven in at one end of the section of a sewer and extracted at the other maintains a continuous through current in a given direction.

The above diagram shows the air being admitted at the lower end of the section and extracted at the upper end, but this arrangement may be reversed, it being as yet an unsettled question amongst sanitary engineers as to whether the air supply should pass up the sewer or down the sewer to secure the best results.

With the "Boyle" System of Ventilation for sewers all smells or noxious gases arising from the sewers being delivered above the rooftops, they cannot prove either a source of annoyance or a danger to health, as is notoriously the case where street ventilators alone are employed.

THE BOYLE SYSTEM OF VENTILATION As applied to SEWERS (Suburban).



A. Boyle's Patent "Air Pump" Ventilator, (Upcast).

B. Upcast Shaft connected with top of Manhole, or Sewer, carried above level of top windows.

C. Boyle's Patent Downcast Ventilator, for catching the Wind from every quarter and driving it down the Shaft D into the Sewer, which is divided into sections, each about 300 feet in length, by Boyle's Triple Flight Flap Valve E.

Each section is ventilated separately. The sizes of the Ventilators and the diameters of the pipes are determined by the size of the Sewer.

E. The Boyle Triple Flight Flap Valve.

The advantages of the "Boyle" System of Ventilation for sewers are that it is economical and easily applied, is entirely self-acting, is always in operation, has no movable parts, cannot get out of order, requires no attention, and there is no after-cost for its maintenance.

THE "BOYLE" DOUBLE AND SINGLE ACTION SYSTEMS OF SOIL PIPE VENTILATION

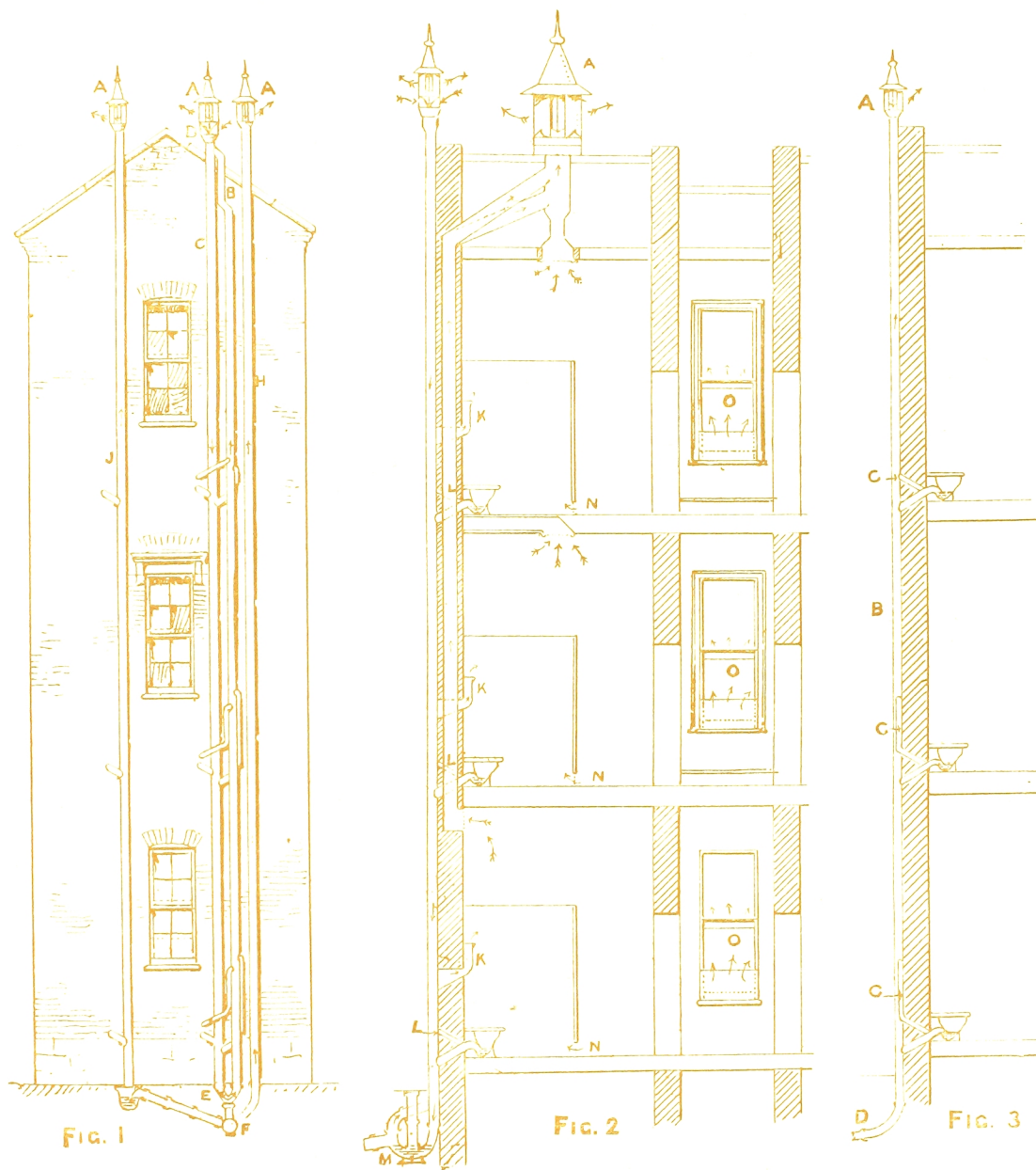


FIG. 1.—Elevation of Double Action System. With this system a double power is obtained, the aspirating force of the "Air-Pump" Ventilator A acting upon the up-cast pipe B, and the pressure of the air down the soil pipe C as it enters through the down-cast Ventilator D attached to the bottom of the "Air-Pump" Ventilator, and which catches the wind from every quarter, maintaining a through current at the junction E immediately above the Disconnecting Trap F. The air inlet being above the roof there is not the same danger from escaping noxious gases as when the inlet is at or a little above ground level. H Ventilating Pipe connected with drain. J Waste Pipe running into open gulley connected with drain.

FIG. 2.—Section showing the ventilation of soil pipe with the "Boyle" Double Action System, also ventilation of W.C.'s with Boyle's Patent "Air-Pump" Ventilator A and air inlets KK. LL 2 in. pipes connected with upcast shafts for the ventilation of discharge pipes and to prevent syphoning of traps. M Disconnecting Trap with inspection chamber.

FIG. 3.—Section of Single Action System. A Boyle's Patent "Air-Pump" Ventilator (upcast). B Soil Pipe. CC Ventilating Pipes connected with discharge pipes to prevent syphoning of traps. D Drain Pipe.



Sewer Ventilator
Upcast No. 225.



Sewer Ventilator
Downcast No. 228



Double Action
Soil Pipe
Ventilator No. 226.

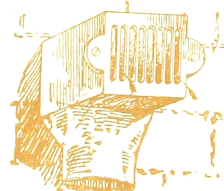


Soil Pipe Ventilator
(Cheap Form) No. 227.

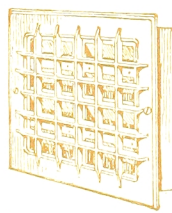


Soil Pipe and
Drain Ventilator
Upcast No. 225.

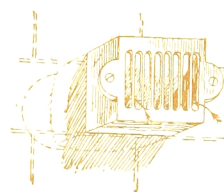
MICA FLAP AIR INLET VALVES, FOR DRAINS AND CESSPOOLS.



Vertical No. 301.



Horizontal No. 303.



Horizontal No. 302.

Prices:— Made in Cast-Iron, Galvanized.

No. 301.				No. 302.				No. 303.			
Pipe.	s.	d.	Ins.	Pipe.	s.	d.	Ins.	Pipe.	s.	d.	Ins.
3 ins.	8	0	7	4 ins.	10	0	8	6 ins.	17	6	15
No. 301. No. 302. No. 303. 11 x 7 front £0 9 0 11 x 9 „ 0 12 6 11 x 11 „ 0 16 6 16 x 11 front £1 2 0 14 x 14 „ 1 2 6 20 x 14 „ 1 17 6											

BOYLE'S PATENT "AIR-PUMP" SEWER·DRAIN AND·SOIL PIPE VENTILATORS (LATEST PATENT)

PRICE LIST Carriage Paid.

Dia of Head Ins	Dia of Pipe Ins	No. 225. £ s d	No. 226. £ s d	No. 227. £ s d	No. 228. £ s d
6	2 1/2	3 0 9	6 0 0	0 7 6	0 0 0
8	3 1/4	0 13 6	1 5 0	0 10 6	0 0 0
10	4 1/2	0 17 6	1 10 0	0 12 6	0 15 0
12	5 1/2	1 2 6	1 15 0	0 15 6	0 18 6
14	6 3/4	1 10 0	0 0 0	1 5 0	0 0 0
16	7 3/4	2 2 0	0 0 0	1 12 6	0 0 0
18	8 3/4	2 15 0	0 0 0	2 0 0	0 0 0
20	9 3/4	3 10 0	0 0 0	2 10 0	0 0 0

N.B. When specifying or ordering the following formula should be used "Boyle's Patent 'Air-Pump' Ventilator Design No., Dia of head, Dia of pipe, No required, Price each"

Note: Each Ventilator has the accompanying TRADE MARK affixed without which none are genuine.



CHEAP FORM TRADE MARK

BOYLE'S PATENT "AIR-PUMP"
VENTILATOR (CHEAP FORM)

DOWN CAST TRADE MARK

BOYLE'S PATENT
DOWNCAST VENTILATOR

REPORTS ON
The "Boyle" System of Ventilation
FOR
SEWERS, DRAINS, AND SOIL PIPES.

EARDLEY BAILEY-DENTON, Esq., C.E.,
Author of "House Sanitation," &c., &c.

"Among the best stationary exhaust
Cowls should be noticed Boyle's Patent
'Air-Pump' Ventilator."

W. EASSIE, Esq., C.E., London,
Author of "Healthy Houses," &c.

"I have often made use of the 'Air-Pump' Ventilator for soil pipes, &c., and consider it most admirable. Its action is continuous, and it *cannot possibly get out of order*. It is decidedly the most efficient foul air withdrawing medium that I ever met with."

GEO. J. C. BROOM, Esq., M.I.C.E., F.G.S.,
Borough Surveyor, St. Helens.

"I have for the past seven or eight years used your 'Air-Pump' Ventilators for the purpose of ventilating the sewers in this town, and have always found them acting satisfactorily."

H. E. STILGOE, Esq.,
Borough Engineer, Dover.

"Where your Patent 'Air-Pump' Ventilators have been used in connection with the sewers and drains at Dover, they have proved satisfactory."

D. C. GODDARD, Esq.,
Borough Surveyor, Kendal.

"I beg to inform you that we have your 'Air-Pump' Ventilators on the sewers of this town and find them to act very satisfactorily in every respect and there is no doubt of them being efficient."

JOHN PARKER, Esq.,
City Surveyor, Hereford.

"I have pleasure in stating that the 'Air-Pump' Ventilators which we have fixed on the 6-in., 8-in. and 9-in. special shafts continue to work satisfactorily."

J. S. BRODIE, Esq.,
Borough Engineer, Whitehaven.

"The sewers in this borough are ventilated by your apparatus and have given every satisfaction."

C. F. MARSTON, Esq., A.M.I.C.E.,
Borough Surveyor, Sutton Coldfield.

"I have used your 'Air-Pump' Ventilators on ventilating shafts and have found them satisfactory in inducing up currents and preventing down-draughts."

A CAUSE OF FAILURE.

Where Ventilators are bought & fixed haphazard without due consideration of the requirements of the buildings or ascertaining if the Ventilators are of sufficient size & properly applied so as to secure their efficient action—failure usually results



RECOMMENDATIONS.

Upon receipt of particulars with rough sketch of any building proposed to be ventilated, stating dimensions, the purpose for which it is used, number of people it accommodates, and if ceiled or open roof, recommendations will be made free of charge, as to the number, sizes and positions of the outlet and inlet Ventilators necessary. 

BOYLE'S
LATEST PATENTED & IMPROVED
VENTILATING APPLIANCES.

PART V.

ALL PREVIOUS PRICE LISTS CANCELLED.

"They are constructed on sound scientific principles, act in strict accordance with the laws of nature, and cannot fail to operate."—PROFESSOR GRANT.

WHEN NATURAL VENTILATION FAILS

"My experience is that a natural system of Ventilation is, in the long run, the most reliable & satisfactory, provided, of course, that properly constructed Ventilators are employed, & that they are skilfully applied by a competent engineer. I am quite aware that there are many very indifferent Ventilators in existence, and also incompetent persons who style themselves 'Ventilating Engineers' & that Natural Ventilation under such auspices might, & probably, would, prove a failure."

CHARLES HOUGHTON, C.E.



INOPERATIVE COWLS.

"The common cowl, or so-called Ventilator, of crude and unscientific construction, which requires a strong wind to make it act, & then usually as a down draught, and which is inoperative when there is no wind, where employed on account of its cheapness, is, to a great extent, responsible for the distrust which those who have had experience of that class of cowl have for Ventilators in general." — *Ventilation*.

Boyle's Patent "Air-Pump" Ventilator.

(Latest Patent.)

"There is no time throughout the whole year but when there is a sufficient movement in the atmosphere to cause the 'Air-Pump' Ventilator to act."—PROFESSOR MACQUORN RANKIN.

Description.

The latest patented form of the "Air-Pump" Ventilator consists of an arrangement of metal plates at certain angles enclosing a central chamber, from which the air is exhausted through a series of protected openings, by the movement of the external air through annular spaces and deflected across the openings at given angles in a compressed form, creating an induced current and also a partial vacuum by exhausting the air from the central chamber and removing the pressure of the atmosphere from the top of the shaft. The foul air in the room being ventilated immediately ascends the shaft to take the place of the air exhausted, a continuous and powerful upward current being maintained.

The "Air-Pump" Ventilator is constructed on sound scientific principles, acts in strict accordance with the laws of nature, and the different parts are so nicely adjusted that the gentlest movement of the air impinging upon them acts as a motive power for exhausting the vitiated air.

Advantages.

"The 'Air-Pump' Ventilator illustrates a great law of nature. The power which operates in producing the currents being as constant as gravity, there is no need of that perpetual examination required in mechanical ventilation."—ARCHITECT.

The "Air-Pump" Ventilator is a fixture, has no mechanical movement, cannot get out of order, requires no attention, and when once fixed there is no after cost.

It creates a continuous and powerful up-draught, is free from down-draught, and impervious to snow, rain, or sleet.

It removes the pressure of the external atmosphere from the top of the outlet shaft, permitting, at all times, of the unimpeded exit of the heated air expelled from the lungs and emanating from the body, ensuring a constant change of the air in a building, even when there is absolutely no perceptible movement of air outside.

It acts in all weathers—in a dense fog and on the closest day in summer.

It does not require wind to make it act.

It can be made to harmonise with every style of architecture, and to fit into turrets.

NOTE.—The extracting power of a properly constructed roof ventilator lies exclusively in the head, and is solely determined by the size of the same, and not by the diameter of the shaft attached to it.

❧ FAILURE ❧

Having received complaints from Architects & others of the failure of the "Air-Pump" Ventilator as applied by them, upon examination being made it was found in every instance that inferior Ventilators had been fixed by the contractor, who, in the majority of cases, had been deceived by misleading price lists issued by the makers of the spurious Ventilators. ❧

PREVENTION.

❧ EACH ❧
"AIR-PUMP" VENTILATOR
HAS THE ACCOMPANYING
❧ TRADE MARK ❧



AFFIXED WITHOUT WHICH
NONE ARE GENUINE ❧
BEWARE OF SPURIOUS
IMITATIONS ❧

How the "Air-Pump" Ventilator IS Always in Operation.

"Science proves that there is not a moment of time but when there is a movement of the air, and that this movement properly utilised is sufficient at all times to change the air in a building and secure ventilation."

—CHARLES HOUGHTON, C.E.

"Incessant movement of the air is a law of nature. We have only to allow the air in our cities and dwellings to take share in this constant change, and ventilation will go on uninterruptedly without our care."—PARKES.

The latest patented form of the "Air-Pump" Ventilator utilises to the fullest degree this continuous movement in the atmosphere as a never-ceasing exhausting force.

Professor MACQUORN RANKIN (Professor of Engineering, Glasgow University), after twelve months' careful experiment, reports: "There is no time throughout the whole year but when there is a sufficient movement of the atmosphere to cause the 'Air-Pump' Ventilator to act."

Independent of its value as an exhaust the "Air-Pump" Ventilator, by removing the pressure of the external atmosphere from the top of the outlet shaft, prevents down-draughts and permits at all times of the unimpeded exit of the warm vitiated air, which naturally ascends to the highest point. This ascensional movement, assisted by the action of the ventilator, induces an inflow of fresh air through the inlets at the lower levels, effectually changing the air in a building, even when there is no perceptible movement of the air outside.

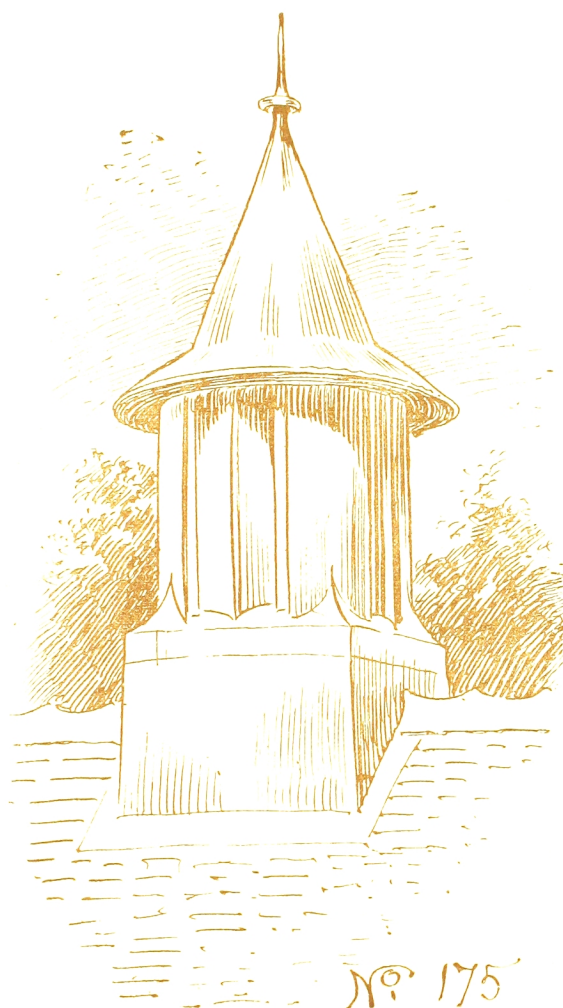
The "Air-Pump" Ventilator does not require wind to make it act.

The "Air-Pump" Ventilator acts efficiently in all conditions of the weather on the coldest day in winter, in a dense fog, and on the closest and warmest day in summer.

BOYLE'S PATENT
"AIR-PUMP"
© VENTILATOR ©
HAS DOUBLE THE
EXTRACTING POWER
AND IS 50 PERCENT.
LESS IN PRICE THAN
EARLIER FORMS. &
The Plainest & Cheap-
est Design (Nº 175) is
also made of a more
ornamental & archi-
tectural character-
of rolled steel plates,
galvanized & painted,
whilst the workman-
ship is of the highest
class.



CAN BE MADE TO
ARCHITECTS' OWN
DESIGNS OR TO FIT
INTO TURRETS. &
Any of the designs in
this Catalogue can
be modified to suit
the requirements of
Architects &&&&



BOYLE'S PATENT "AIR-PUMP" VENTILATOR (LATEST PATENT)

IT HAS DOUBLE THE
EXTRACTING POWER
OF EARLIER FORMS.

PRICE LIST Carriage Paid.

Dia. of Head. Ins.	Inside of Base Ins.	Dia. of Pipe Ins.	Dia. of Pipe Recom- mended.	N ^o 175. £ s. d.
12	12X12	4 to 8	6 Ins.	1 5 0
14	14X14	5 " 9	7 "	1 10 0
16	16X16	6 " 10	8 "	2 2 0
18	18X18	7 " 11	9 "	2 15 0
20	20X20	8 " 12	10 "	3 10 0
24	24X24	10 " 14	12 "	4 10 0
27	27X27	11 " 16	14 "	5 5 0
30	30X30	12 " 18	15 "	6 10 0
36	36X36	15 " 21	18 "	8 15 0
42	42X42	17 " 24	21 "	11 15 0
48	48X48	20 " 28	24 "	14 17 6
54	54X54	24 " 32	28 "	18 18 0

ROOF SEATS NOT INCLUDED.

MADE FIREPROOF TO FIT OVER
SUNBURNERS 10% EXTRA.

FOR TABLE OF SIZES REQUIRED,
~~SEE PAGE 148~~ SEE PAGES 148-149.

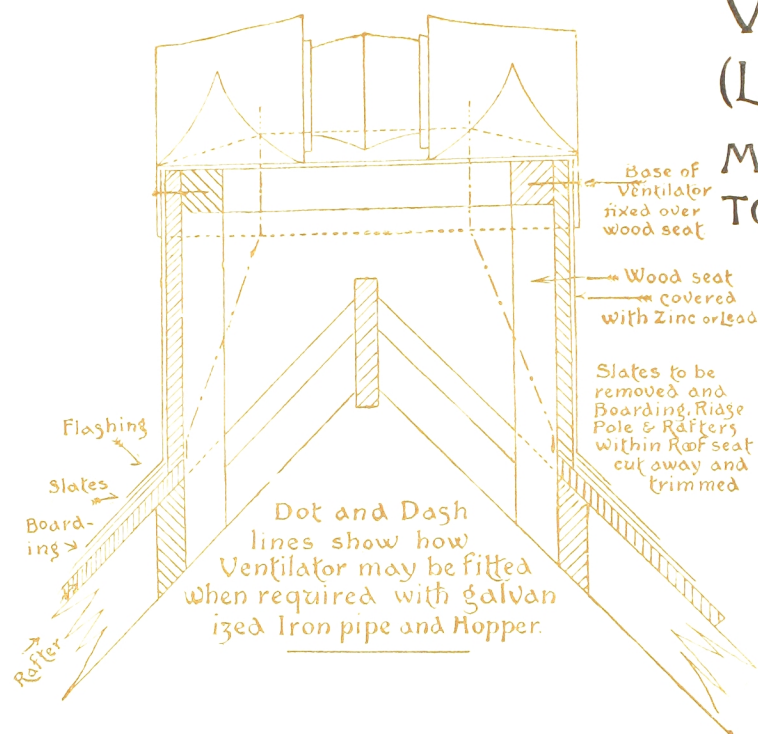
N.B. When specifying or
ordering the following formula
should be used "Boyle's Patent
'Air-Pump' Ventilator Design N^o....,
Dia of head, Dia of pipe,
N^o required, Price each"

Note: Each Ventilator
has the accompany-
ing TRADE MARK
affixed without which
none are genuine.



BOYLE'S PATENT "AIR-PUMP" VENTILATOR (LATEST PATENT)

METHOD OF FIXING TO AN OPEN ROOF.



NOTE:— When ordering hopper send sectional drawing of roof giving exact pitch.

1/2 PLAN

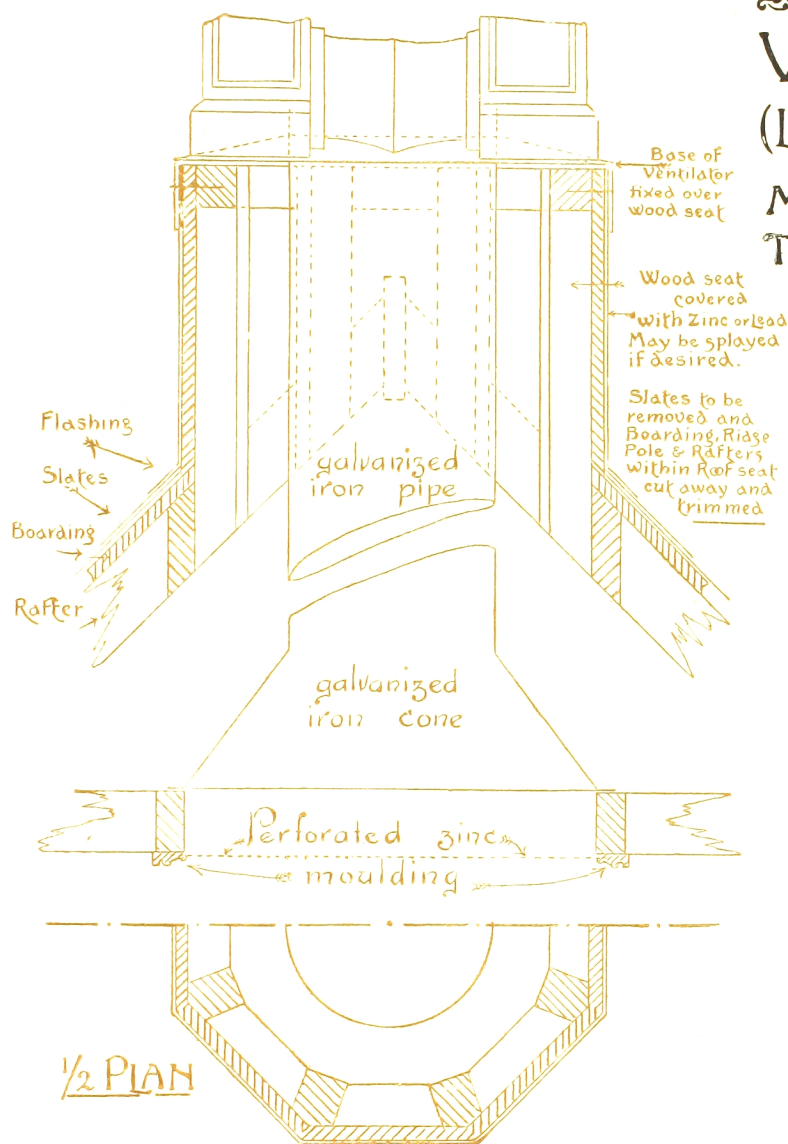


IMPORTANT.

To ensure the efficient action of a ROOF VENTILATOR at all times it should be fixed above the highest point of the roof clear of all obstructions so that the wind can have direct and unimpeded access to it from every quarter.

BOYLE'S PATENT "AIR-PUMP" VENTILATOR (LATEST PATENT)

METHOD OF FIXING TO A CEILED ROOF.



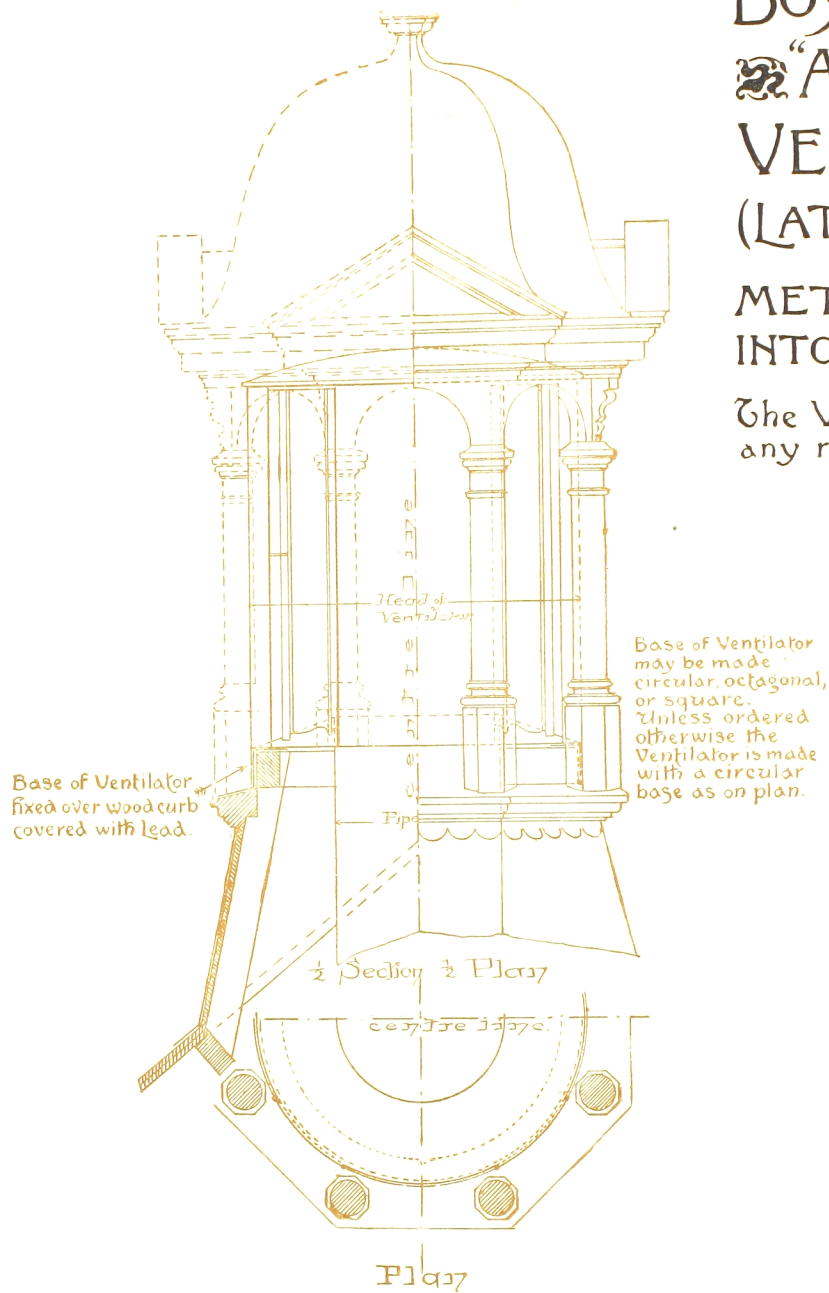
IMPORTANT.

To ensure the efficient action of a ROOF VENTILATOR at all times it should be fixed above the highest point of the roof clear of all obstructions so that the wind can have direct and unimpeded access to it from every quarter.

BOYLE'S PATENT "AIR-PUMP" VENTILATOR (LATEST PATENT)

METHOD OF FIXING
INTO A TURRET

The Ventilator can be made
any required height.



IMPORTANT.

To ensure the efficient action of a ROOF VENTILATOR at all times it should be fixed above the highest point of the roof clear of all obstructions so that the wind can have direct and unimpeded access to it from every quarter.



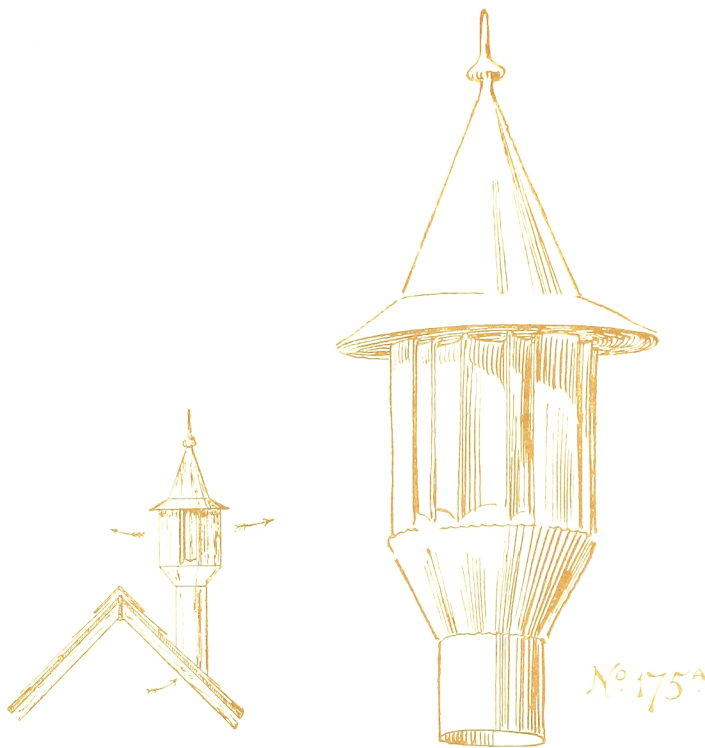
BOYLE'S PATENT
 "AIR-PUMP"
 VENTILATOR
 (LATEST PATENT)
 AS FITTED INTO
 A TURRET

Price, same as No 175,
 (see page 89.)

N.B. When specifying or
 ordering the following formula
 should be used "Boyle's Patent
 'Air Pump' Ventilator for
 fitting into a Turret. Dia. of
 head, Dia. of pipe,
 Height overall, No required,
 Price each (State whether
 round, octagonal or square base)."

BOYLE'S PATENT "AIR-PUMP" VENTILATOR (LATEST PATENT)

FOR FITTING OVER EX-
TERNAL PIPES OR ON
SLOPE OF ROOF with FLANGE



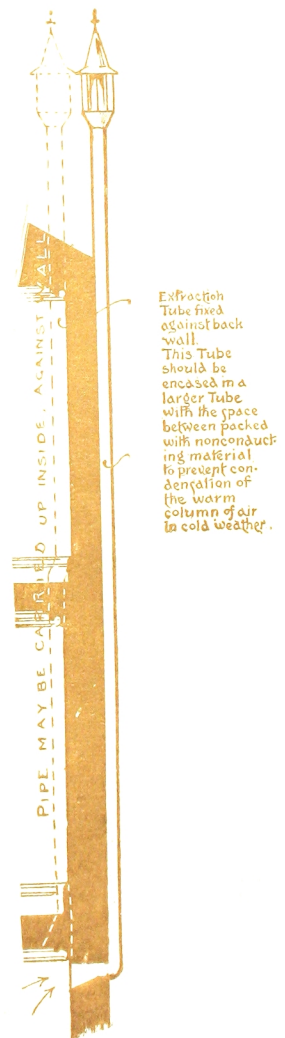
Price, same as No 175,
(see page 89.)

IMPORTANT.

To ensure the efficient action of a ROOF VENTILATOR at all times it should be fixed above the highest point of the roof clear of all obstructions so that the wind can have direct and unimpeded access to it from every quarter.

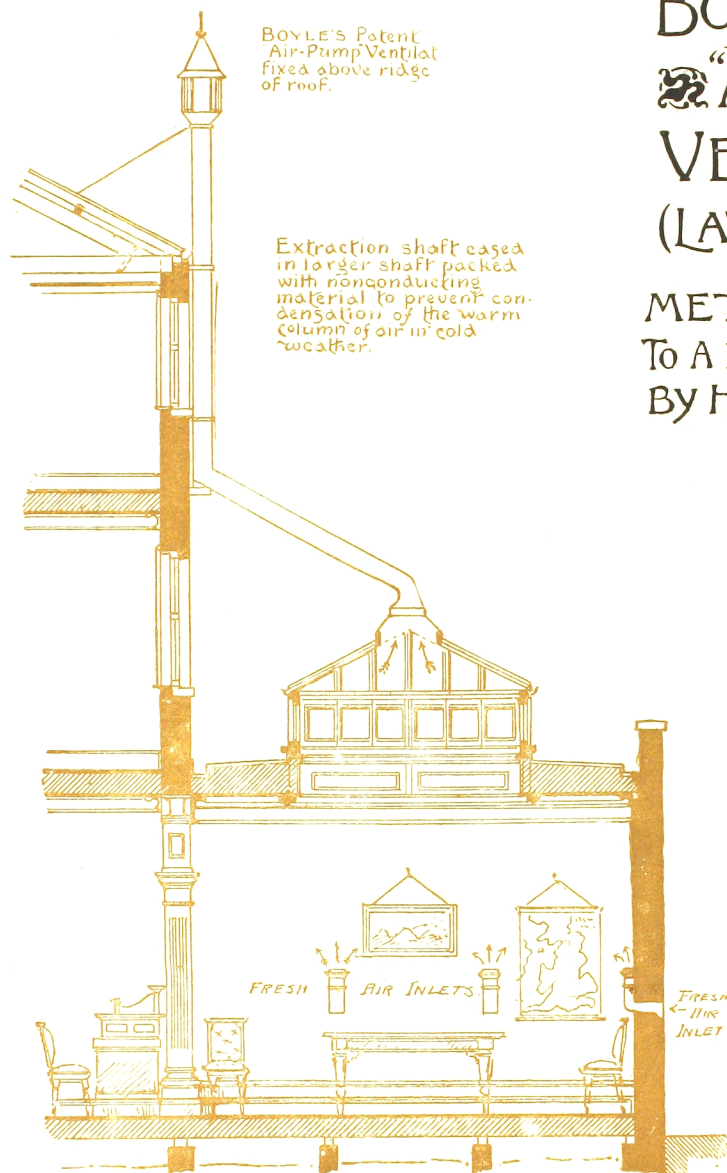
N.B. When specifying or ordering the following formula should be used "Boyle's Patent 'Air-Pump' Ventilator Design No., Dia of head, Dia of pipe, No required, Price each"

Note: Each Ventilator has the accompanying TRADE MARK affixed without which none are genuine.



BOYLE'S PATENT "AIR-PUMP" VENTILATOR (LATEST PATENT)

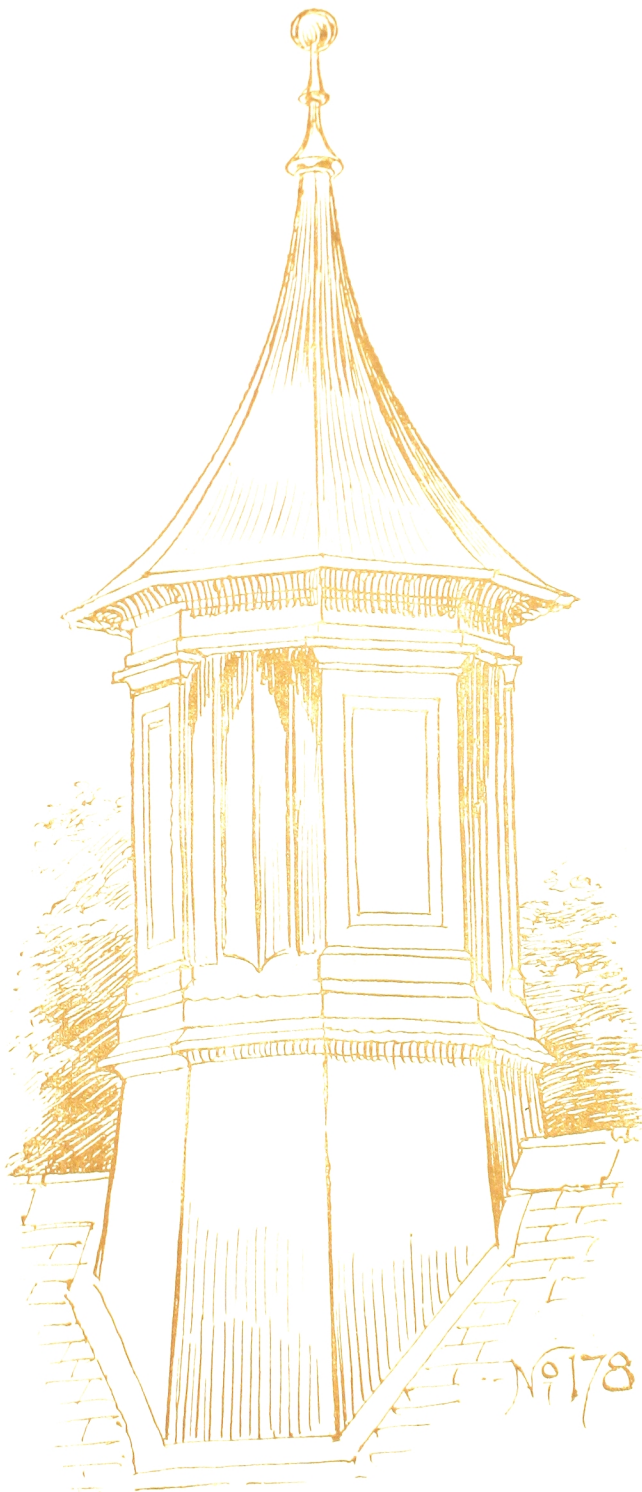
METHOD OF FIXING
TO A ROOM OVERTOPPED
BY HIGHER BUILDINGS



IMPORTANT.

The "Air-Pump" Ventilator should be fixed above the level of the ridge of the higher building so that the wind can reach it unobstructedly from every quarter. No Roof Ventilator will act efficiently if overtopped by higher structures. Where it is impracticable to carry the Ventilator above the higher building a self-acting valve should be fixed in the shaft

BOYLE'S PATENT "AIR-PUMP" VENTILATOR (LATEST PATENT)



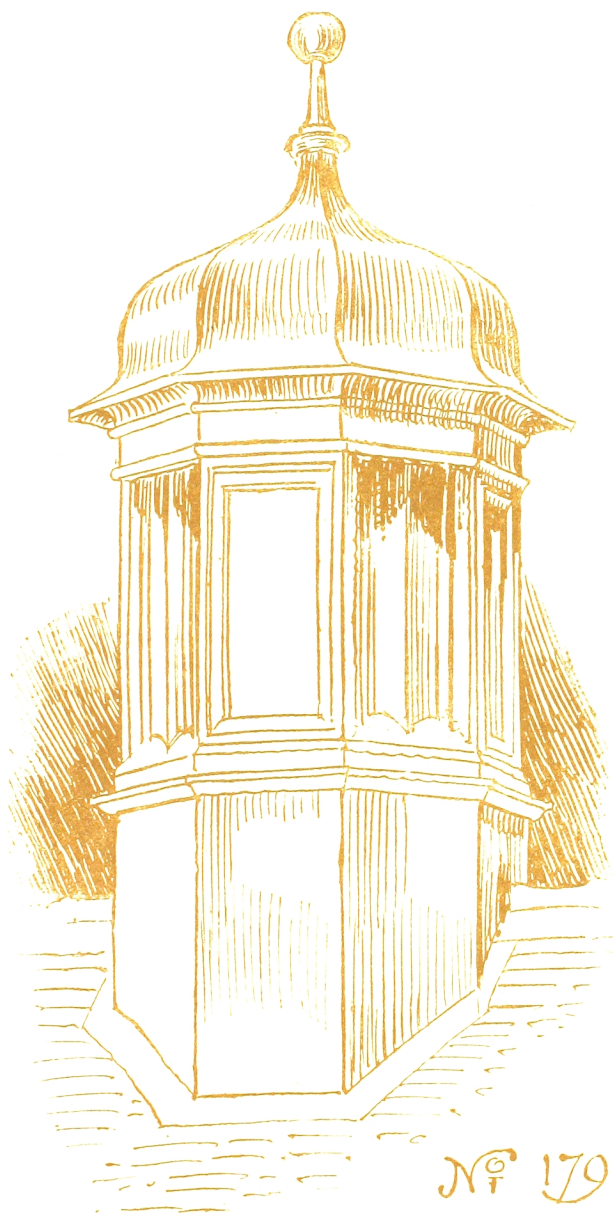
PRICE LIST

Dia of Head Ins.	Dia of Pipe Ins.	Dia of Pipe Recom- mended.	No 178. £ s d.
18	7 to 11	9 ins.	4 4 0
20	8 „ 12	10 „	4 17 6
24	10 „ 14	12 „	6 10 0
27	11 „ 16	14 „	7 10 0
30	12 „ 18	15 „	9 0 0
36	15 „ 21	18 „	12 10 0
42	17 „ 24	21 „	16 15 0
48	20 „ 28	24 „	21 10 0
54	24 „ 32	28 „	27 10 0

ROOF SEATS NOT INCLUDED.

N.B. When specifying or ordering the following formula should be used "Boyle's Patent 'Air-Pump' Ventilator Design No...., Dia of head, Dia of pipe, No required, Price each"

BOYLE'S PATENT "AIR-PUMP" VENTILATOR (LATEST PATENT)



PRICE LIST

Dia. of Head. Ins.	Dia. of Pipe. Ins.	Dia. of Pipe Recom- mended	No 179. £. s. d.
18.	7 to 11.	9 ins.	4 15 0.
20.	8 „ 12.	10 „	5 10 0.
24.	10 „ 14.	12 „	7 7 0.
27.	11 „ 16.	14 „	8 15 0.
30.	12 „ 18.	15 „	10 10 0.
36.	15 „ 21.	18 „	14 10 0.
42.	17 „ 24.	21 „	18 18 0.
48.	20 „ 28.	24 „	24 10 0.
54.	24 „ 32.	28 „	31 10 0.

ROOF SEATS NOT INCLUDED.

N.B. When specifying or ordering the following formula should be used "Boyle's Patent 'Air-Pump' Ventilator Design No., Dia. of head, Dia. of pipe, No required, Price each"



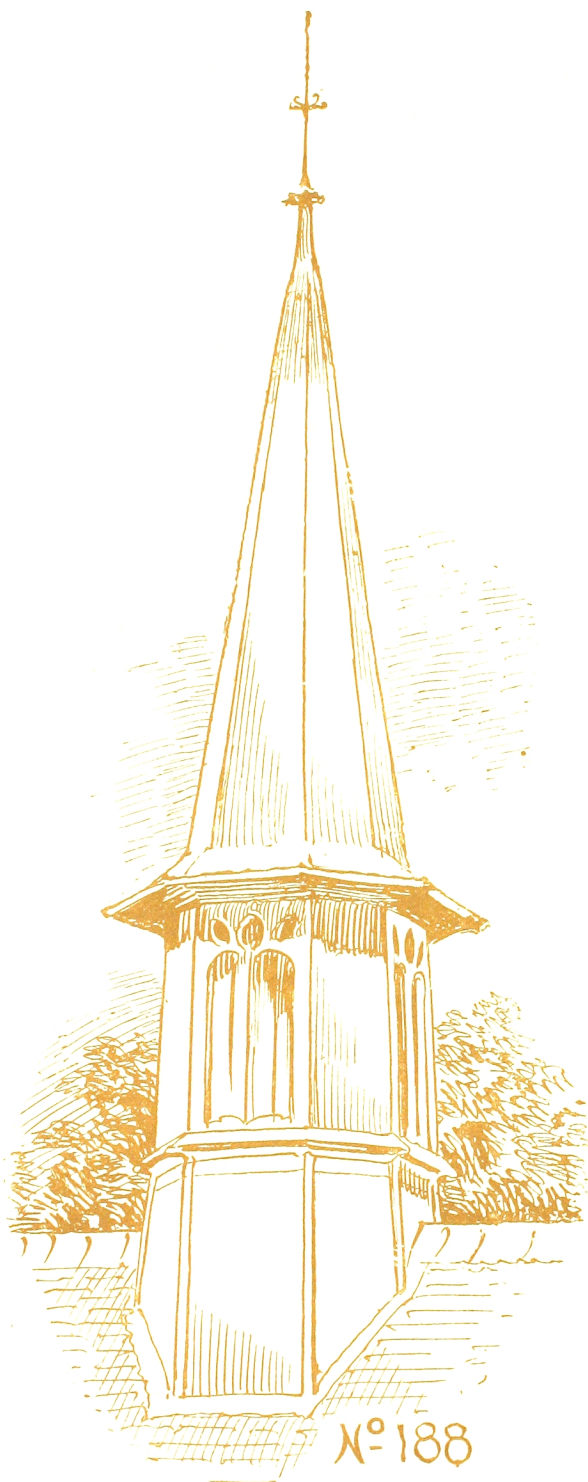
BOYLE'S PATENT "AIR-PUMP" VENTILATOR (LATEST PATENT)

PRICE LIST

Dia of Head. Ins.	Dia of Pipe. Ins.	Dia of Pipe Recom- mended.	No 186. £. s. d.
18.	7 to 11.	9 ins.	7 0 0.
20.	8 „ 12.	10 „	8 0 0.
24.	10 „ 14.	12 „	9 15 0.
27.	11 „ 16.	14 „	11 15 0.
30.	12 „ 18.	15 „	14 10 0.
36.	15 „ 21.	18 „	18 0 0.
42.	17 „ 24.	21 „	24 0 0.
48.	20 „ 28.	24 „	31 0 0.
54.	24 „ 32.	28 „	39 0 0.

ROOF SEATS NOT INCLUDED.

N.B. When specifying or ordering the following formula should be used "Boyle's Patent 'Air-Pump' Ventilator Design No...., Dia of head, Dia of pipe, No required, Price each"



BOYLE'S PATENT "AIR-PUMP" VENTILATOR (LATEST PATENT)

PRICE LIST

Dia of Head. Ins.	Dia of Pipe. Ins.	Dia of Pipe Recon- mended.	Nº 188. £. s. d.
24.	10 to 14.	12 ins.	10 10 0.
27.	11 „ 16.	14 „	12 10 0.
30.	12 „ 18.	15 „	14 17 6.
36.	15 „ 21.	18 „	20 10 0.
42.	17 „ 24.	21 „	25 0 0.
48.	20 „ 28.	24 „	32 0 0.
54.	24 „ 32.	28 „	39 15 0.

ROOF SEATS NOT INCLUDED.

N.B. When specifying or ordering the following formula should be used "Boyle's Patent 'Air-Pump' Ventilator Design Nº....., Dia of head....., Dia of pipe....., Nº required....., Price each....."



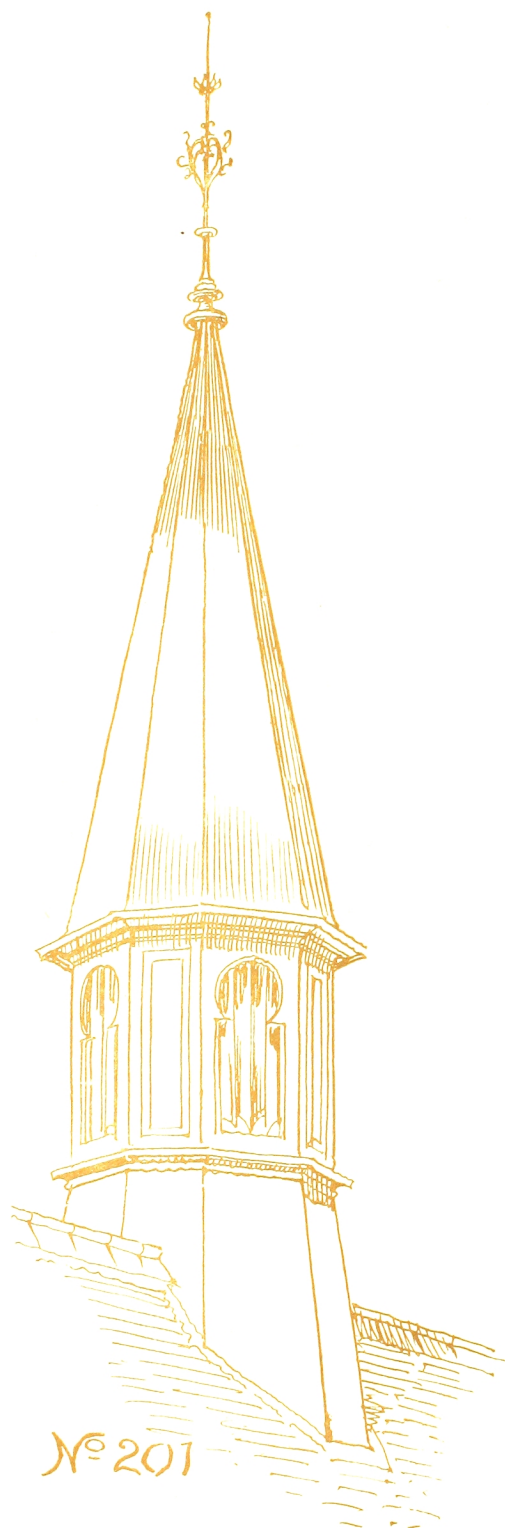
BOYLE'S PATENT "AIR-PUMP" VENTILATOR (LATEST PATENT)

PRICE LIST

Dia of Head. Ins.	Dia of Pipe. Ins.	Dia of Pipe Recom- mended	No 194A £. s. d.
24.	10 to 14.	12 ins.	16 10 0.
27.	11 „	16. 14 „	19 15 0.
30.	12 „	18. 15 „	25 0 0.
36.	15 „	21. 18 „	34 0 0.
42.	17 „	24. 21 „	42 10 0.
48.	20 „	28. 24 „	52 10 0.
54.	24 „	32. 28 „	65 0 0.

ROOF SEATS NOT INCLUDED.

N.B. When specifying or ordering the following formula should be used "Boyle's Patent 'Air-Pump' Ventilator Design No...., Dia of head, Dia of pipe, No required, Price each"



BOYLE'S PATENT "AIR-PUMP" VENTILATOR (LATEST PATENT)

PRICE LIST

Dia of Head. Ins.	Dia of Pipe. Ins.	Dia of Pipe Recom- mended.	Nº 201. £. s. d.
24.	10 to 14.	12 ins.	10 10 0.
27.	11 „ 16.	14 „	12 10 0.
30.	12 „ 18.	15 „	14 17 6.
36.	15 „ 21.	18 „	20 10 0.
42.	17 „ 24.	21 „	25 0 0.
48.	20 „ 28.	24 „	32 0 0.
54.	24 „ 32.	28 „	39 15 0.

ROOF SEATS NOT INCLUDED.

N.B. When specifying or ordering the following formula should be used "Boyle's Patent 'Air-Pump' Ventilator Design Nº....., Dia of head, Dia of pipe, Nº required, Price each"

BOYLE'S PATENT "AIR-PUMP" VENTILATOR (LATEST PATENT)

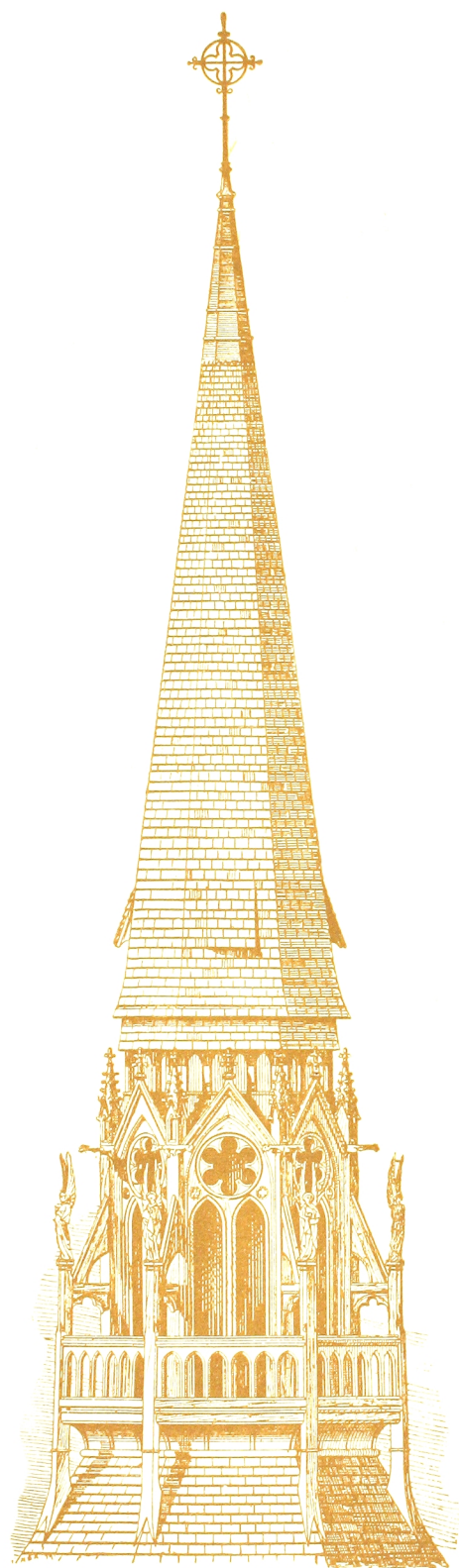


PRICE LIST

Dia of Head. Ins.	Dia of Pipe. Ins.	Dia of Pipe Recom- mended.	No 181. £ s. d.
24.	10 to 14.	12 ins.	16 10 0.
27.	11 „ 16.	14 „	19 15 0.
30.	12 „ 18.	15 „	25 0 0.
36.	15 „ 21.	18 „	34 0 0.
42.	17 „ 24.	21 „	42 10 0.
48.	20 „ 28.	24 „	52 10 0.
54.	24 „ 32.	28 „	65 0 0.

ROOF SEATS NOT INCLUDED.

N.B. When specifying or ordering the following formula should be used "Boyle's Patent 'Air-Pump' Ventilator Design No., Dia of head, Dia of pipe, No required, Price each"



BOYLE'S PATENT
 "AIR-PUMP"
 VENTILATOR
 (LATEST PATENT)

FITTED INTO TURRET,
 CHRIST CHURCH,
 LAMBETH

REV. NEWMAN HALL,
 CHRIST CHURCH, LAMBETH.
 (ROWLAND HILL MEMORIAL CHURCH).

"I consider our ventilation
 very successful."

BOYLE'S PATENT "AIR-PUMP" VENTILATOR (LATEST PATENT)



No 183



No 184

HAS DOUBLE THE
EXTRACTING POWER
OF EARLIER FORMS.

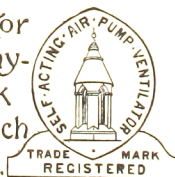
PRICE LIST

Dia of Head. Ins.	Dia of Pipe. Ins.	Dia of Pipe Recom- mended.	No 177. £ s. d.	No 183. £ s. d.	No 184. £ s. d.	No 187. £ s. d.
18.	7 to 11.	9 ins.	3 10 0.	5 5 0.	7 5 0.	6 6 0.
20.	8 „ 12.	10 „	4 5 0.	6 0 0.	8 10 0.	7 7 0.
24.	10 „ 14.	12 „	5 10 0.	8 0 0.	10 15 0.	9 10 0.
27.	11 „ 16.	14 „	6 10 0.	9 12 6.	12 12 0.	11 0 0.
30.	12 „ 18.	15 „	8 0 0.	11 11 0.	15 10 0.	12 17 6.
36.	15 „ 21.	18 „	10 17 6.	15 19 0.	19 15 0.	16 16 0.
42.	17 „ 24.	21 „	14 17 6.	20 15 0.	27 10 0.	22 0 0.
48.	20 „ 28.	24 „	18 10 0.	26 19 0.	35 15 0.	29 0 0.
54.	24 „ 32.	28 „	23 0 0.	34 15 0.	43 10 0.	36 0 0.

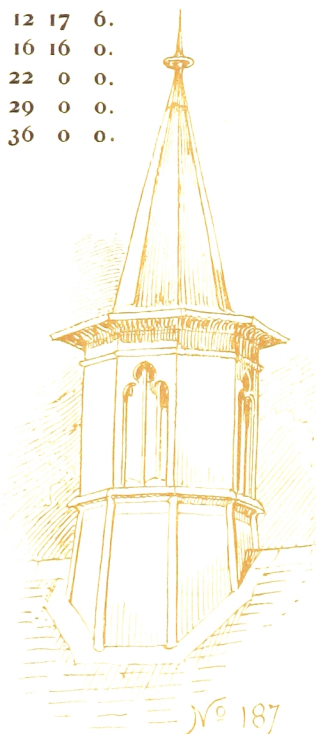
ROOF SEATS NOT INCLUDED.

N.B. When specifying or ordering the following formula should be used "Boyle's Patent 'Air-Pump' Ventilator Design No., Dia of head, Dia of pipe, No required, Price each"

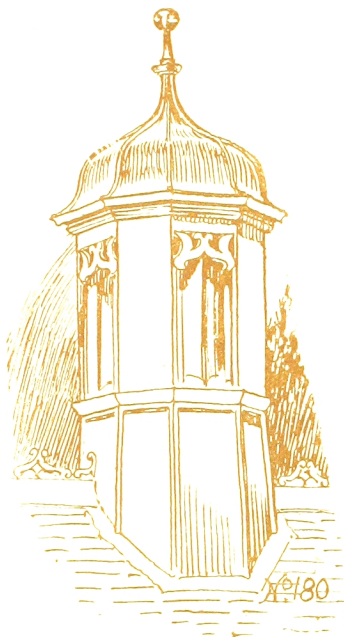
Note: Each Ventilator has the accompanying TRADE MARK affixed without which none are genuine.



No 177



No 187



BOYLE'S PATENT "AIR-PUMP" VENTILATOR (LATEST PATENT)

HAS DOUBLE THE
EXTRACTING POWER
OF EARLIER FORMS.

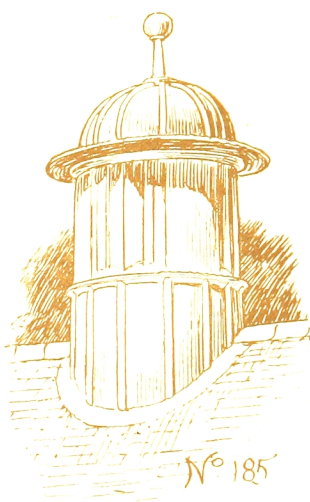


PRICE LIST

Dia of Head. Ins.	Dia of Pipe. Ins.	Dia of Pipe Recom- mended.	No 180 & 185.	No 189.	No 190.
			£ s. d.	£ s. d.	£ s. d.
18.	7 to 11.	9 ins.	5 10 0.	7 7 0.	9 5 0.
20.	8 "	12. 10 "	6 6 0.	8 15 0.	11 11 0.
24.	10 "	14. 12 "	8 8 0.	11 11 0.	14 17 0.
27.	11 "	16. 14 "	9 9 0.	14 10 0.	18 5 0.
30.	12 "	18. 15 "	12 0 0.	16 10 0.	20 15 0.
36.	15 "	21. 18 "	16 10 0.	20 10 0.	28 0 0.
42.	17 "	24. 21 "	21 10 0.	28 18 0.	37 10 0.
48.	20 "	28. 24 "	27 10 0.	37 0 0.	47 17 0.
54.	24 "	32. 28 "	34 15 0.	46 15 0.	59 19 0.

ROOF SEATS NOT INCLUDED.

N.B. When specifying or
ordering the following formula
should be used "Boyle's Patent
'Air-Pump' Ventilator Design No.,
Dia of head, Dia of pipe,
No required, Price each"



Note: Each Ventilator
has the accompany-
ing TRADE MARK
affixed without which
none are genuine.





BOYLE'S PATENT "AIR-PUMP" VENTILATOR (LATEST PATENT)

HAS DOUBLE THE
EXTRACTING POWER
OF EARLIER FORMS.

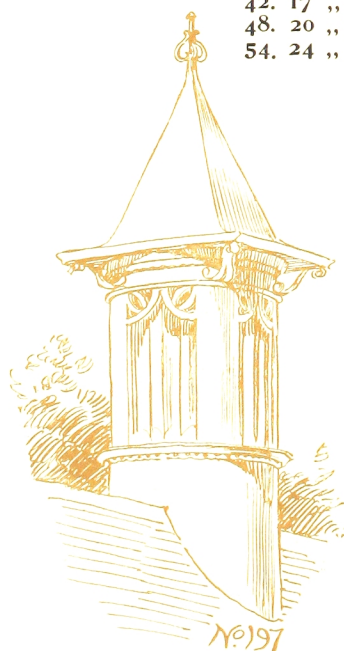


PRICE LIST

Dia of Head. Ins.	Dia of Pipe. Ins.	Dia of Pipe Recom- mended.	No 179A £. s. d.	No 182. £. s. d.	No 197. £. s. d.	No 198 £. s. d.
18.	7 to 11.	9 ins.	5 15 0.	5 5 0.	7 0 0.	7 7 0.
20.	8 "	12. 10 "	6 15 0.	6 6 0.	8 5 0.	8 15 0.
24.	10 "	14. 12 "	8 17 6.	8 0 0.	10 10 0.	11 11 0.
27.	11 "	16. 14 "	10 10 0.	9 15 0.	12 5 0.	14 10 0.
30.	12 "	18. 15 "	12 15 0.	11 11 0.	15 5 0.	16 10 0.
36.	15 "	21. 18 "	16 16 0.	15 10 0.	19 0 0.	20 10 0.
42.	17 "	24. 21 "	22 0 0.	20 0 0.	27 0 0.	28 18 0.
48.	20 "	28. 24 "	28 0 0.	27 0 0.	35 0 0.	37 0 0.
54.	24 "	32. 28 "	35 0 0.	34 0 0.	42 10 0.	46 15 0.

ROOF SEATS NOT INCLUDED.

N.B. When specifying or ordering the following formula should be used "Boyle's Patent 'Air-Pump' Ventilator Design No...., Dia of head, Dia of pipe, No required, Price each"



Note: Each Ventilator has the accompanying TRADE MARK affixed without which none are genuine.





N^o 193

BOYLE'S PATENT "AIR-PUMP" VENTILATOR (LATEST PATENT)

HAS DOUBLE THE
EXTRACTING POWER
OF EARLIER FORMS.



N^o 196

PRICE LIST

Dia of Head.	Dia of Pipe.	Dia of Pipe Recommended.	N ^o 192.	N ^o 193 & 196.	N ^o 195.
Ins.	Ins.		£. s. d.	£. s. d.	£. s. d.
24.	10 to 14.	12 ins.	14 5 0.	19 15 0.	22 0 0.
27.	11 "	16. 14 "	17 10 0.	24 10 0.	28 10 0.
30.	12 "	18. 15 "	19 19 0.	30 0 0.	38 0 0.
36.	15 "	21. 18 "	26 15 0.	39 0 0.	49 0 0.
42.	17 "	24. 21 "	35 15 0.	50 0 0.	63 0 0.
48.	20 "	28. 24 "	45 15 0.	63 0 0.	79 0 0.
54.	24 "	32. 28 "	57 0 0.	76 15 0.	95 0 0.

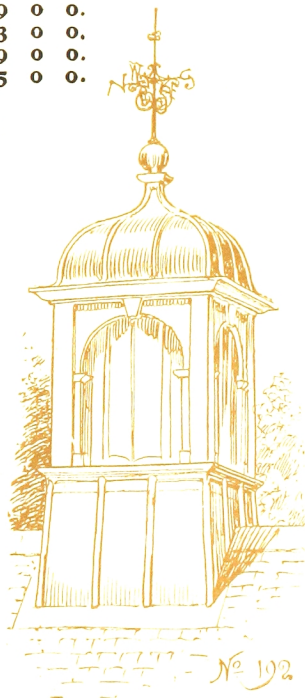
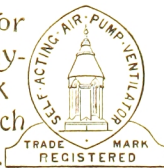
ROOF SEATS NOT INCLUDED.

N.B. When specifying or ordering the following formula should be used "Boyle's Patent 'Air-Pump' Ventilator Design N^o..., Dia of head, Dia of pipe, N^o required, Price each"

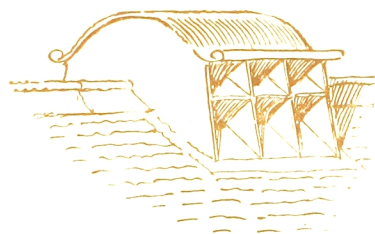


N^o 195

Note: Each Ventilator has the accompanying TRADE MARK affixed without which none are genuine.



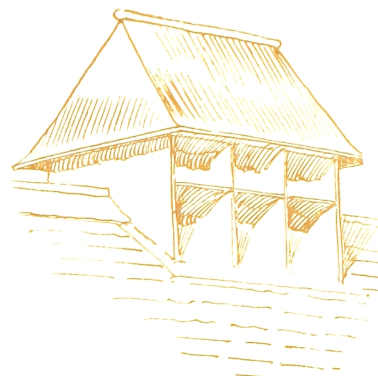
N^o 192



No 212.

BOYLE'S PATENT "AIR-PUMP" RIDGE VENTILATOR (LATEST PATENT)

IT HAS DOUBLE THE
EXTRACTING POWER
OF EARLIER FORMS.



No 213

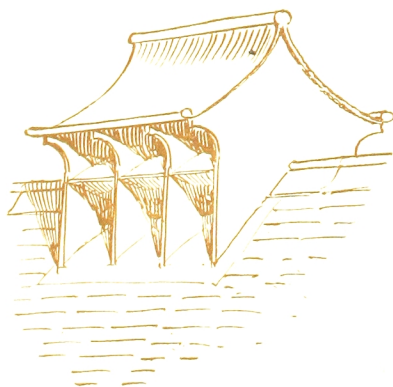
These Ventilators consist of one section of the "Air-Pump" Ventilator placed horizontally on the ridge. They are useful Ventilators, but like all Ventilators of their class, they are not so effective at all times as the Turret form of "Air-Pump" Ventilator, which acts with equal efficiency with the wind blowing from any direction.

FOR SIZES TO BE USED FOR DIFFERENT BUILDINGS, SEE PAGE 143.

PRICE LIST

				No 212.	No 213.	No 214.	No 215.
Section of 18 ins. dia. A.P.V. per ft. run				£0 17 6.	£1 7 6.	£1 10 0.	£1 15 0.
" 24 "	"	"	"	1 5 0.	1 17 6.	2 0 0.	2 7 6.
" 30 "	"	"	"	1 15 0.	2 7 6.	2 12 6.	3 3 0.
" 36 "	"	"	"	2 2 0.	2 15 0.	3 3 0.	3 15 0.

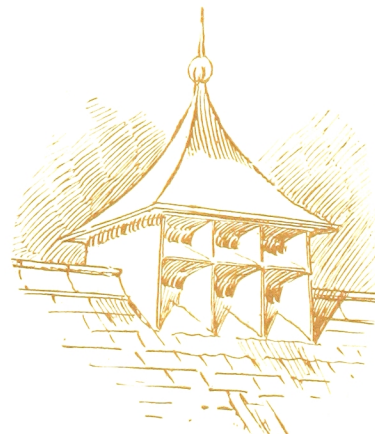
When fitted to ceiled roofs, Pipes & Cones extra, according to length & size
These Ventilators can be fitted with regulating or selfacting Valves (See p. 116)



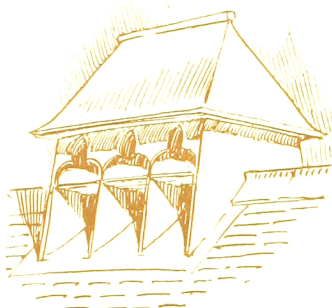
No 214

N.B. When specifying or ordering the following formula should be used "Boyle's Patent Air-Pump' Ridge Ventilator, No....., Dia....., Length....., Price pr. foot....., Pitch of roof....., Slated or Tiled

Note: Each Ventilator has the accompanying TRADE MARK affixed without which none are genuine.



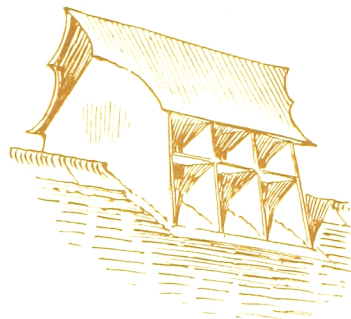
No 215



Nº 216

BOYLE'S PATENT "AIR-PUMP" RIDGE VENTILATOR (LATEST PATENT)

It HAS DOUBLE THE
EXTRACTING POWER
OF EARLIER FORMS.



Nº 217

These Ventilators consist of one section of the "Air-Pump" Ventilator placed horizontally on the ridge. They are useful Ventilators, but like all Ventilators of their class, they are not so effective at all times as the Turret form of "Air-Pump" Ventilator, which acts with equal efficiency with the wind blowing from any direction.

FOR SIZES TO BE USED FOR DIFFERENT BUILDINGS, SEE PAGE 148.

PRICE LIST

Section of 18 ins. dia. A.P.V. per ft. run	Nº 216 & 217.	Nº 218.	Nº 219.
" 24 "	£1 17 6.	£2 0 0.	£2 15 0.
" 30 "	2 12 6.	2 15 0.	3 10 0.
" 36 "	3 10 0.	3 15 0.	4 12 6.
" 36 "	4 5 0.	4 10 0.	5 10 0.

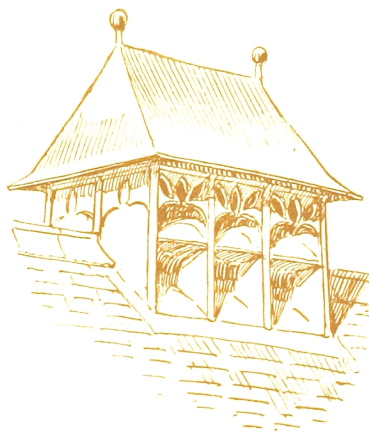
When fitted to ceiled roofs, Pipes & Cones extra, according to length & size. These Ventilators can be fitted with regulating or selfacting Valves (See p. 116).



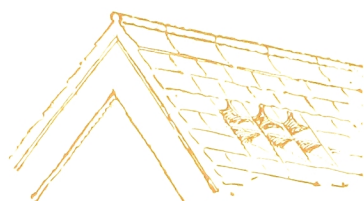
Nº 218

H.B. When specifying or ordering the following formula should be used "Boyle's Patent Air-Pump Ridge Ventilator. No., Dia., Length, Price per foot, Pitch of roof, Slated or Tiled

Note: Each Ventilator has the accompanying TRADE MARK affixed without which none are genuine.

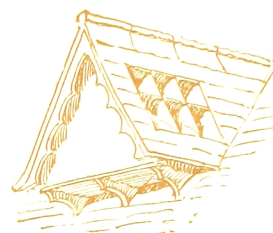


Nº 219



No 221.
External appearance.

BOYLE'S PATENT "AIR-PUMP" CONCEALED VENTILATOR (LATEST PATENT)



As fitted into Dormer.

This adaptation of the Latest Patented form of the "Air-Pump" Ventilator consisting of one section of that Ventilator as shown in the accompanying diagrams, is intended to be employed where it is impracticable or deemed unadvisable for aesthetic reasons to use the Turret form of Ventilator. As it is obvious that Ventilators of this class cannot be fully operative except when the wind is in certain directions, they are liable to the objection, which applies to every form of them, that there will be certain periods when their action will be reduced. They can be constructed to suit either open or ceiled roofs, and are recommended as being the most powerful and reliable Ventilators of their class.

FOR SIZES TO BE USED FOR DIFFERENT BUILDINGS, SEE PAGES 148-9.

PRICE LIST

Section of 18 ins. dia. A.P.V. (width of base not exceeding 30 ins.) per foot run						No 221.
"	24	"	"	"	40	£0 17 6.
"	30	"	"	"	50	1 5 0.
"	36	"	"	"	60	1 15 0.
"		"	"	"		2 2 0.

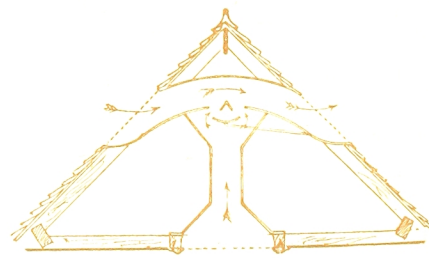
When fitted to ceiled roofs, Pipes & Cones extra, according to length & size. These Ventilators can be fitted with regulating or selfacting Valves (see p. 116).

N.B. When specifying or ordering the following formula should be used "Boyle's Patent 'Air-Pump' Concealed Ventilator, No., Dia., Length, Price pr. foot, Pitch of roof, Slated or Tiled."

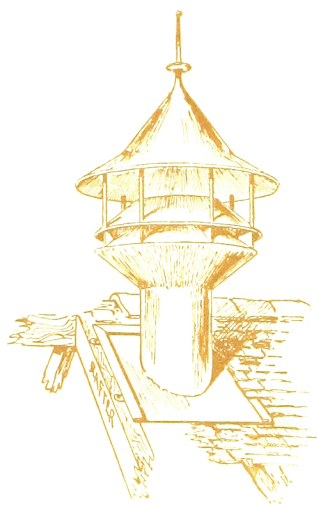


As fitted in open roof.

Note: Each Ventilator has the accompanying TRADE MARK affixed without which none are genuine.



As fitted in ceiled roof



No 230

BOYLE'S PATENT "AIR-PUMP" VENTILATOR (LATEST PATENT) CHEAP FORM.

FOR FACTORIES, WORKSHOPS,
STABLES, LAUNDRIES, AND
OTHER BUILDINGS WHERE
EXPENSE IS GENERALLY AN
IMPORTANT CONSIDERATION.



No 231

PRICE LIST

Dia. of Head.	Inside measurement of base of No 231.	Dia. of Pipe. Ins.	Dia. of Pipe. Recommended.	No 230.	Roof Flange extra.	No 231.	No 232.	Vertical Current Ventilator. No 232A.
Ins.				£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
12.	9" x 9"	6 to 8.	6 ins.	0 17 6.	0 3 6.	1 0 0.	1 7 6.	1 5 0.
14.	10 1/2" x 10 1/2"	7 "	7 "	1 1 0.	0 4 0.	1 5 0.	1 12 6.	1 10 0.
16.	12" x 12"	8 "	8 "	1 7 6.	0 4 6.	1 12 0.	2 2 0.	2 2 0.
18.	13 1/2" x 13 1/2"	9 "	9 "	1 12 6.	0 5 4.	1 18 0.	2 15 0.	2 15 0.
20.	15" x 15"	10 "	10 "	1 18 6.	0 6 6.	2 4 0.	3 10 0.	3 10 0.
24.	18" x 18"	12 "	12 "	2 12 6.	0 8 0.	2 17 6.	4 10 0.	4 10 0.
30.	22 1/2" x 22 1/2"	15 "	15 "	3 7 6.	0 12 6.	3 17 6.	6 10 0.	6 10 0.
36.	27" x 27"	18 "	18 "	4 10 0.	0 17 6.	5 5 0.	8 15 0.	8 15 0.
42.	31 1/2" x 31 1/2"	21 "	21 "	5 18 6.	1 7 6.	6 17 6.	11 15 0.	11 15 0.
48.	36" x 36"	24 "	24 "	7 10 0.	1 18 0.	8 10 0.	14 17 6.	14 17 6.

ROOF SEATS NOT INCLUDED.

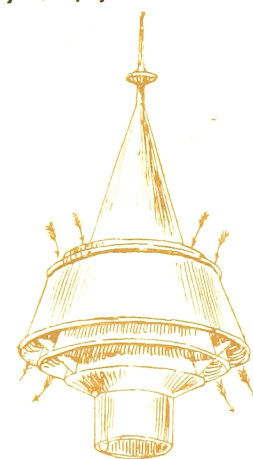
N.B. When specifying or ordering the following formula should be used "Boyle's Patent 'Air-Pump' Ventilator & Cheap Form (or Vertical current) Design No....., Dia. of head....., Dia. of pipe....., No required....., Price each....., Pitch of roof for No 230....., Slated or Tiled.

CHEAP FORM TRADE MARK.

BOYLE'S PATENT "AIR-PUMP"
VENTILATOR (CHEAP FORM)



No 232



Boyle's Patent 'Air-Pump' Vertical Current Ventilator for Buildings over-topped by higher Structures.

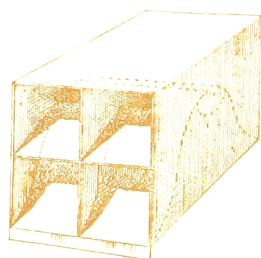
No 232A



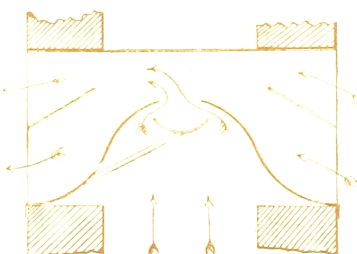
BOYLE'S PATENT "AIR-PUMP" VENTILATOR (LATEST PATENT) FOR FITTING INTO VENTILATING FLUES

THIS METHOD OF VENTILATING WHICH AT ITS BEST IS MERELY A MAKESHIFT SHOULD ONLY BE RESORTED TO WHEN IT IS IMPRACTICABLE TO FIX VENTILATORS ON THE ROOF OR ON THE TOP OF A CHIMNEY STACK WHICH ARE MORE EFFECTUAL PLANS.

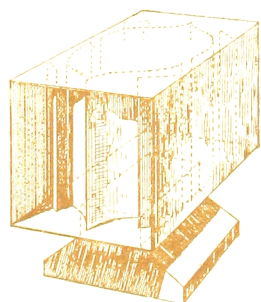
PRICE LIST



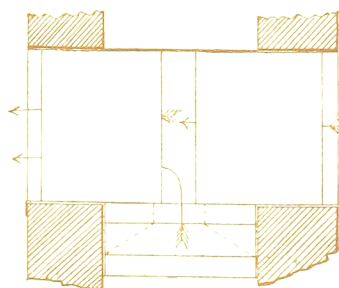
No 223.
Horizontal.



Section.



No 224.
Vertical.



Section.

Size of Ventilator.	Size of Flue	No 223.
ins. ins. ins.	ins. ins.	
18 x 9 x 9.	9 x 9.	£1 10 0.
18 x 14 x 9.	14 x 9.	2 2 0.
23 x 14 x 15.	14 x 14.	3 7 6.

Size of Ventilator.	Size of Flue	No 224.
ins. ins. ins.	ins. ins.	
18 x 9 x 9.	9 x 9.	£2 9 0.
18 x 14 x 12.	14 x 9.	3 5 0.
23 x 14 x 15.	14 x 14.	4 10 0.

N.B. When specifying or ordering the following formula should be used "Boyle's Patent 'Air-Pump' Ventilator for ventilating flues. Design No. Dimensions Price each"

Design No 224 has double the exhaust outlet of No 223.

Note: Each Ventilator has the accompanying TRADE MARK affixed without which none are genuine.



PATENT
PUMPS
FOR
VENTILATING
INTO
FLUES

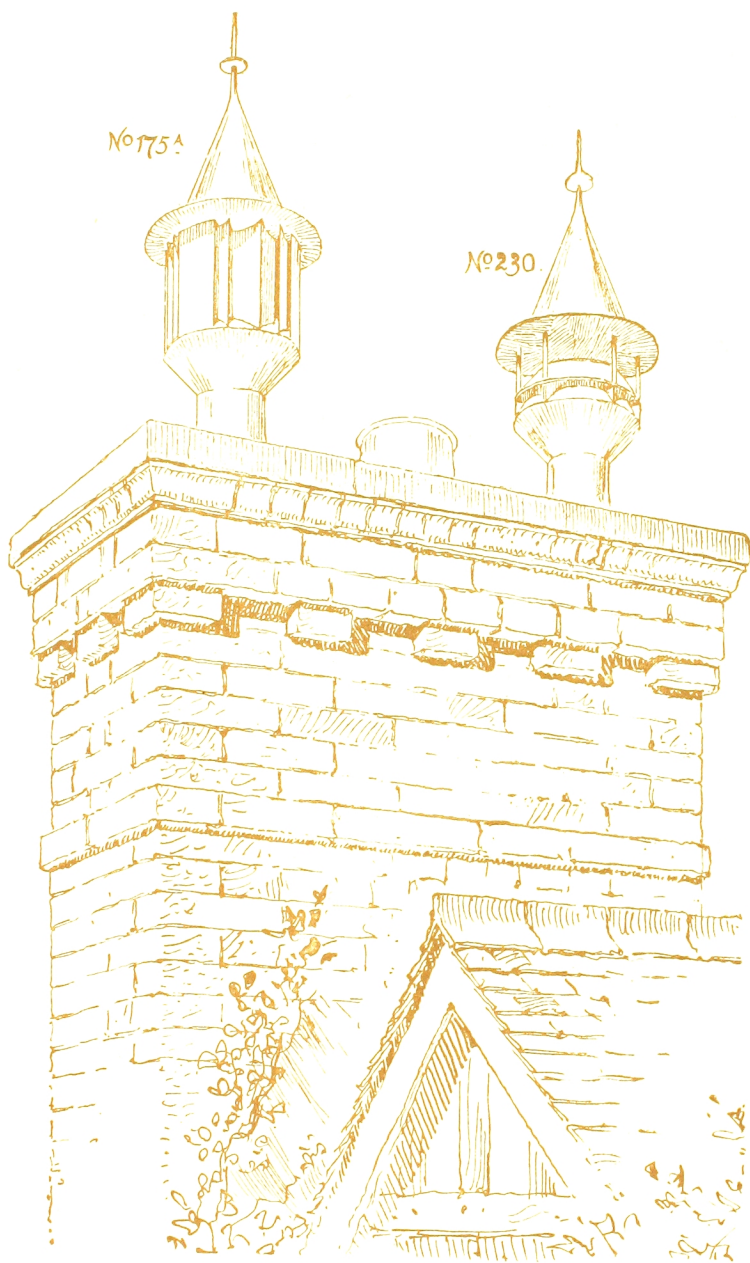
VENTILATING
MERELY A
ONLY BE
IT IS IM-
PORTANT
ON THE
WHICH
PLANS

No 223.
1 10 0.
2 2 0.
3 7 6.

No 224.
1 9 0.
2 5 0.
3 10 0.

g or
mulo
stent
for
No

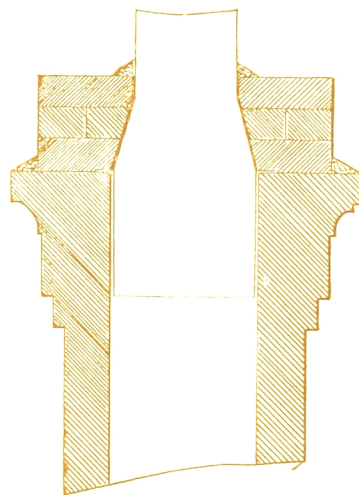
REGISTERED
TRADE
MARK



BOYLE'S PATENT "AIR-PUMP" VENTILATOR (LATEST PATENT)

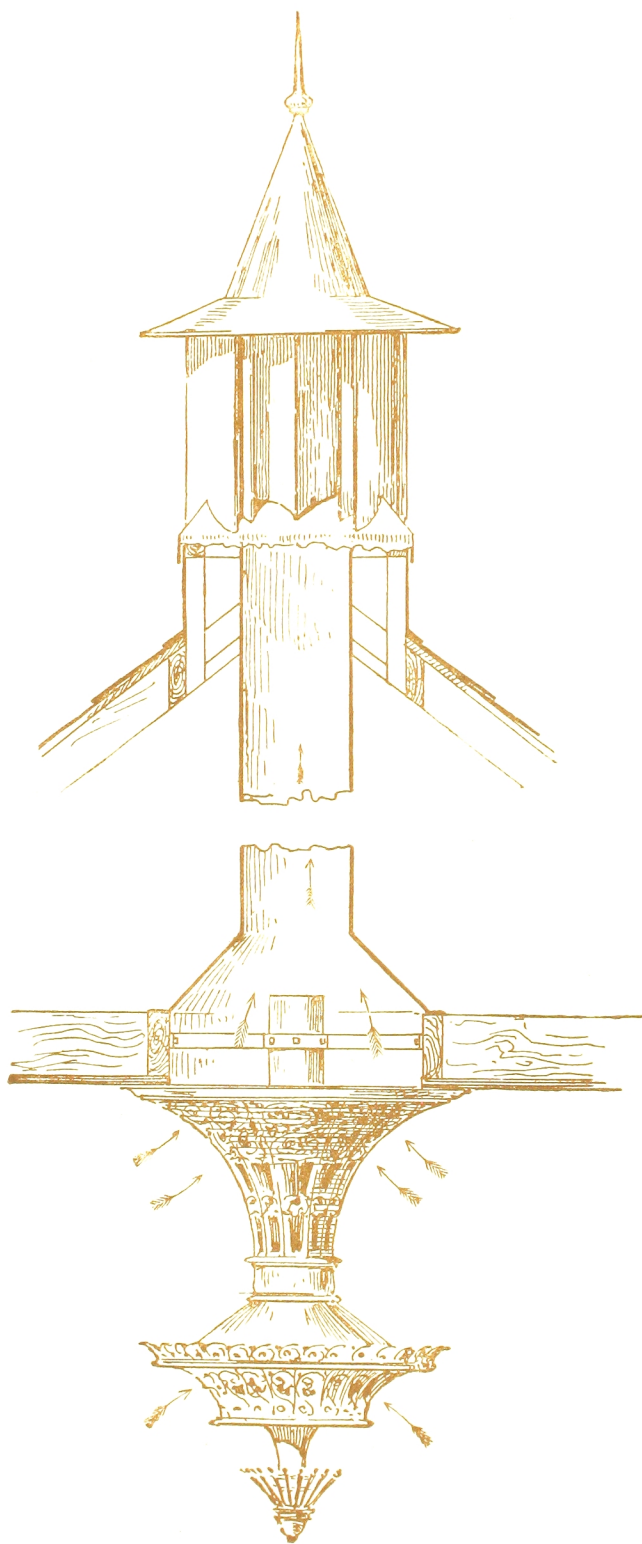
METHOD OF FIXING
ON A CHIMNEY STACK

For Prices see pages 89 & 111.
Prices quoted for Flanges and
Slips for fitting into Flues. &



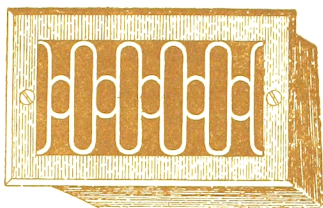
Section showing method of
fixing into Ventilating flue

BOYLE'S PATENT
 "AIR-PUMP"
 VENTILATOR
 (LATEST PATENT)
 AS APPLIED TO
 A SUNBURNER

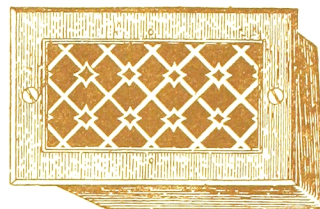


MICA FLAP OUTLET VENTILATORS.

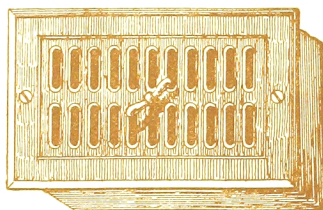
FOR THE DISCHARGE OF VITIATED AIR INTO SMOKE OR VENTILATING FLUES.



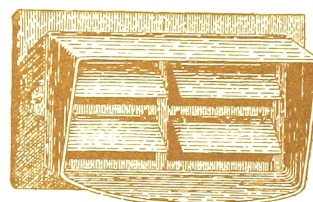
No. 345.



No. 348.



No. 346.



Back View.

PRICE LIST

Nos.	Quality.	Size of Front Size of Box	11x5 ins.* 9x3 "	11x7 ins.* 9x5 1/2 "	11x9 ins. 9x7 1/2 "	11x11 ins. 9x9 1/2 "	16x11 ins. 13 1/2 x 9 1/2 "
345.—Plain Iron	...	...	£0 4 0.	£0 6 0.	0 9 0.	£0 11 0.	£0 16 0.
346.—Plain Iron Hit-and-Miss Fronts	...	...	0 9 0.	0 9 0.	0 13 0.	0 16 0.	1 2 0.
347.—Japanned Bronze	...	...	0 5 0.	0 7 0.	0 10 0.	0 13 0.	0 18 0.
348.—Japanned White and Gold	...	...	0 6 0.	0 8 0.	0 11 0.	0 15 0.	1 0 0.
349.—Brass Trellis Fronts	...	...	0 7 0.	0 10 0.	0 14 0.	0 18 0.	1 5 0.
350.—Brass Hit-and-Miss Fronts	...	...	1 0 0.	1 0 0.	1 5 0.	1 13 0.	2 6 0.

*Also Vertical Ventilators 5x11 ins., and 7x11 ins. at same prices.

NOISELESS MICA FLAP VENTILATORS (OUTLET).

IRON FRONTS.

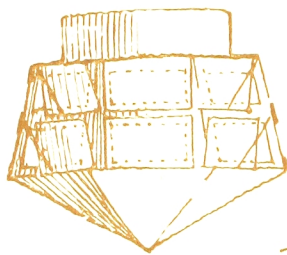
	Front Size Box Size	11x5 ins. 9x3 "	8x8 ins. 6 1/2 x 6 1/2 "	11x7 ins. 9x5 "	11x9 ins. 9x7 1/2 "	11x11 ins. 9x9 "	16x11 ins. 14x9 "
360.—Plain Iron	...	7/0.	10/0.	10/0.	14/0.	17/6.	25/0.
361.—Painted Bronze	...	7/4.	10/6.	10/6.	14/9.	18/3.	26/0.
362.—Japanned Bronze	...	7/9.	11/0.	11/0.	15/6.	19/0.	27/0.
363.—Japanned White & Gold	...	8/6.	12/0.	12/0.	16/6.	20/6.	29/6.
364.—Galvanized	...	8/0.	11/6.	11/6.	16/3.	20/3.	28/9.

BRASS TRELLIS FRONTS.

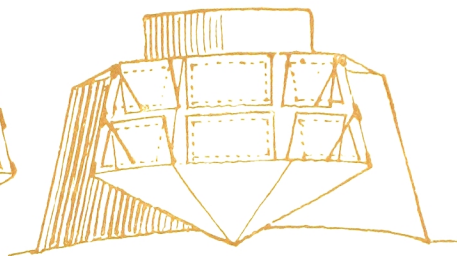
	Front Size Box Size	11x5 ins. 9x3 "	8x8 ins. 6 1/2 x 6 1/2 "	11x7 ins. 9x5 "	11x9 ins. 9x7 1/2 "	11x11 ins. 9x9 "	16x11 ins. 14x9 "
370.—Painted Bronze Lacquered Brass Front Plate	...	10/0.	14/0.	14/6.	19/0.	24/6.	34/6.
371.—Japanned Bronze	...	10/9.	15/0.	15/6.	20/6.	26/0.	36/6.
372.—Japanned White & Gold	...	11/6.	16/0.	16/6.	21/6.	27/6.	38/6.
373.—Galvanized Iron	...	11/0.	15/9.	16/6.	21/9.	27/6.	38/6.

BOYLE'S **SELF ACTING &** **REGULATING VALVES.**

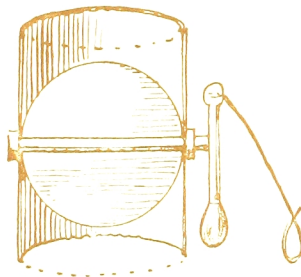
THE FLAPS OF THE SELF-ACTING VALVES ARE MADE OF SPECIALLY PREPARED OILED SILK. WHEN USED IN CONNECTION WITH SUN-BURNERS THEY ARE MADE OF MICA.



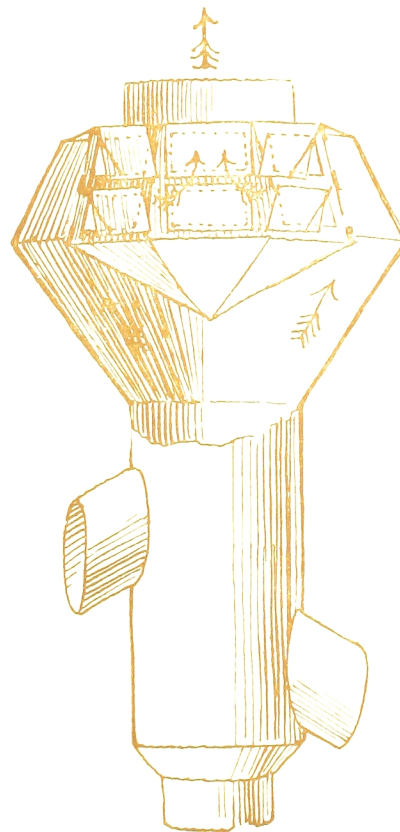
Self-acting Valve
for open roof.



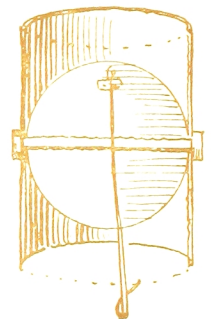
Self-acting Valve for
single pipes fixed in
ceiling cone.



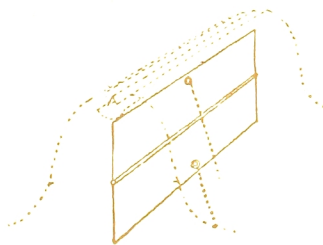
Regulating Valve
for ceiling roof.



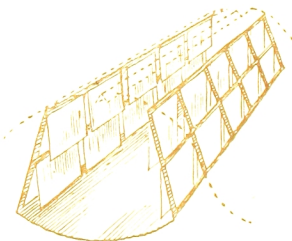
Vertical Self-acting Valve
fixed in main pipe.



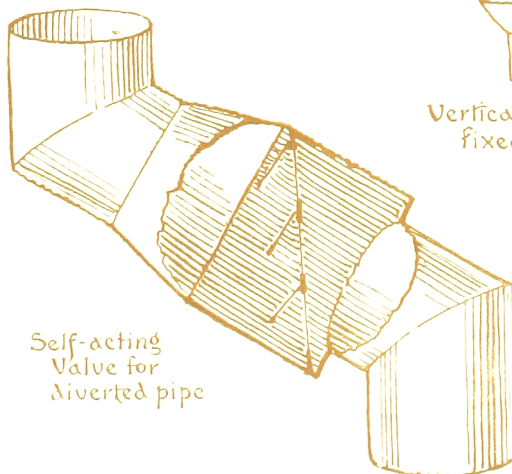
Regulating Valve
for open roof.



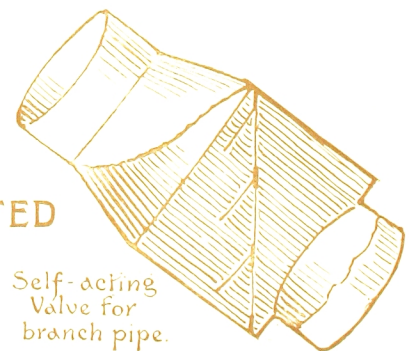
Regulating Valve for con-
cealed or ridge ventilator



Self-acting Valve for con-
cealed or ridge ventilator

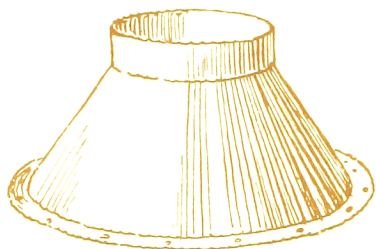


Self-acting
Valve for
diverted pipe



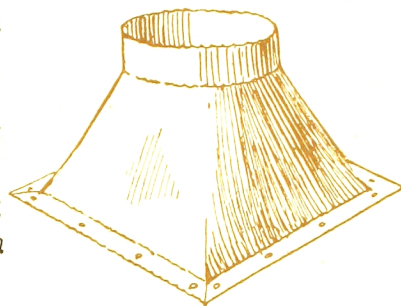
Self-acting
Valve for
branch pipe.

PRICES QUOTED

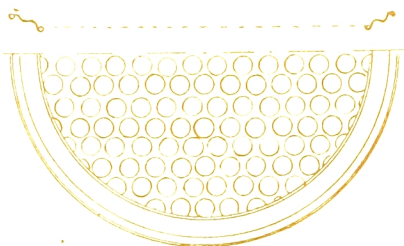


Ceiling Cone.

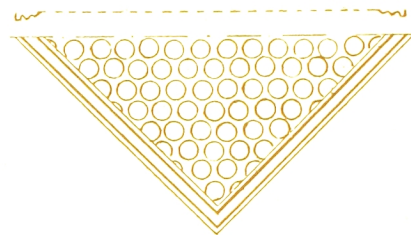
FITTINGS EMPLOYED
IN THE APPLICATION OF
THE "BOYLE" SYSTEM
OF VENTILATION.
Made in galvanized iron



Ceiling Hopper.



Circular perforated
zinc panel with
moulding.



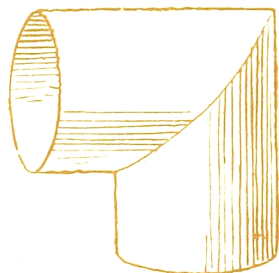
Square perforated
zinc panel with
moulding.



for open roof.

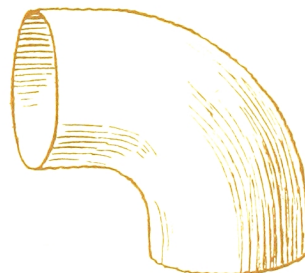


Perforated Zinc double
panel for open roof.



Knee.

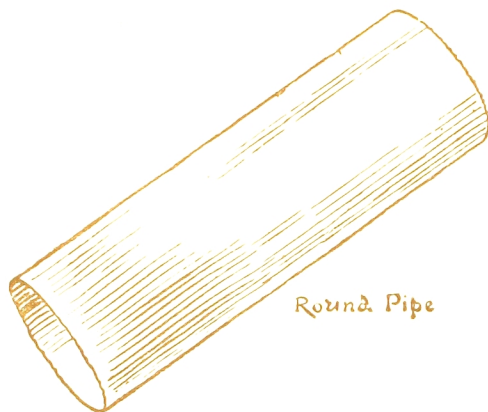
ESTIMATES GIVEN.



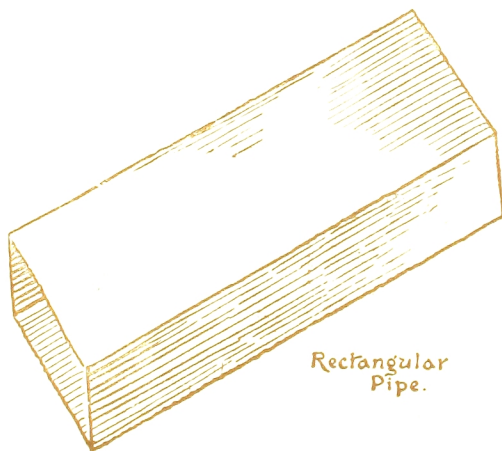
Bend.

FITTINGS EMPLOYED IN THE APPLICATION OF THE "BOYLE" SYSTEM OF VENTILATION

Made in galvanized iron



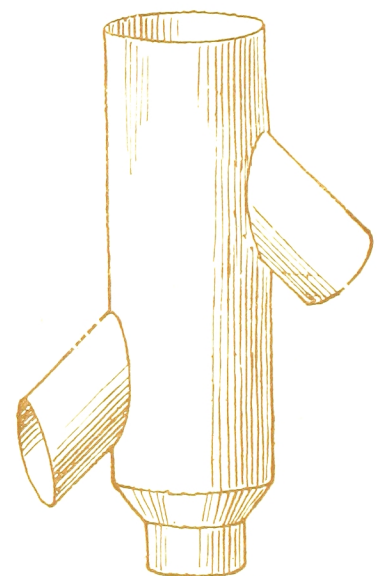
Round Pipe



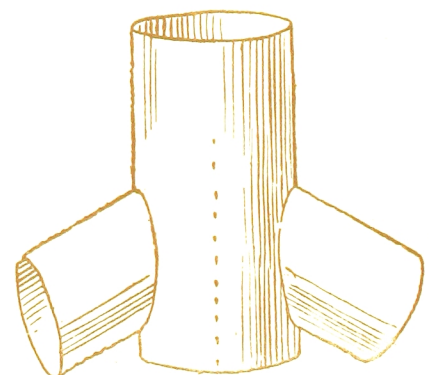
Rectangular
Pipe.



Double pipe
with nonconducting
Packing

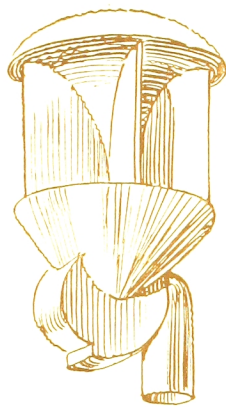


Main pipe with three
Junctions & taper piece.



Main pipe with two
junctions and centre
deflecting plate.

ESTIMATES GIVEN.



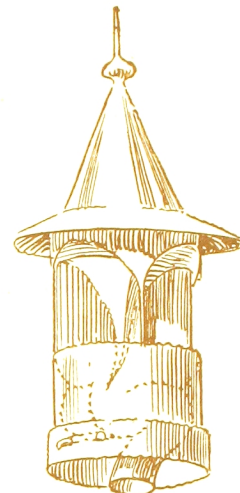
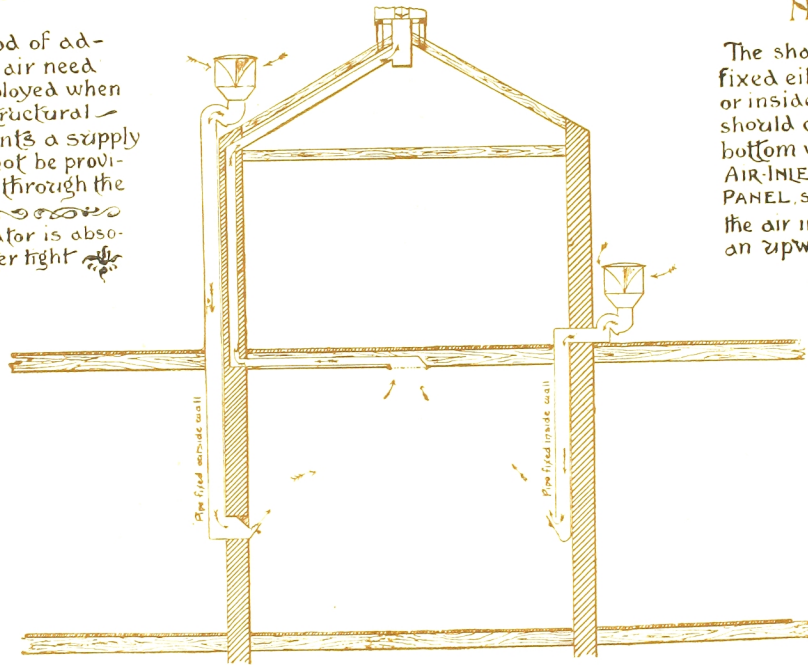
N^o 265.

This method of admitting the air need only be employed when owing to structural arrangements a supply of Air cannot be provided direct through the walls. The Ventilator is absolutely water tight.

BOYLE'S PATENT DOWNCAST VENTILATOR (LATEST PATENT)

This Ventilator is intended to be fixed at the eaves of the roof or in a lower position for the purpose of catching the wind and forcing it down the shaft into the room to be ventilated.

METHODS OF FIXING.



N^o 266

The shaft may be fixed either outside or inside the wall & should connect at the bottom with a Boyle's AIR-INLET BRACKET or PANEL, so as to deliver the air into the room in an upward direction.

PRICE LIST

Dia of Head.	Dia of Pipe.	N ^o 265	N ^o 266
Ins.	Ins.	£ s. d.	£ s. d.
16.	6 to 10.	1 12 6.	2 2 0.
18.	7 " 11.	2 0 0.	2 15 0.
20.	8 " 12.	2 10 0.	3 10 0.
24.	10 " 14.	3 10 0.	4 10 0.

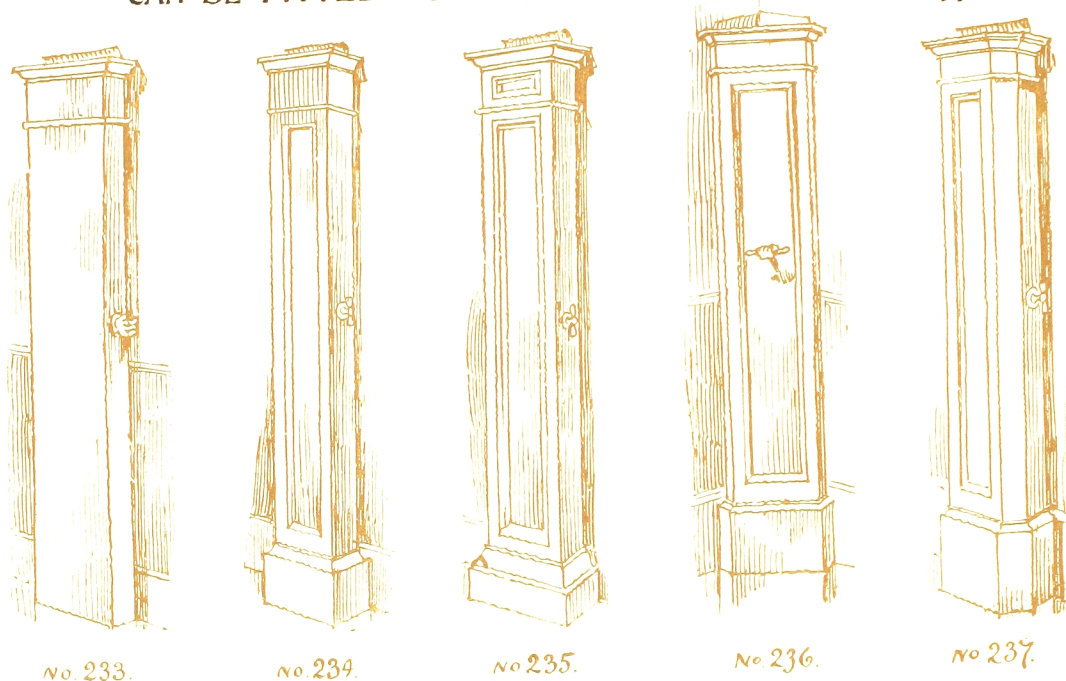
N.B. When specifying or ordering the following formula should be used "Boyle's Patent Downcast Ventilator Design N^o....., Dia. of head....., Dia. of pipe....., N^o required....., Price each....."

DOWN CAST TRADE MARK.

BOYLE'S PATENT
DOWNCAST VENTILATOR

BOYLE'S AIR-INLET TUBES.

FITTED WITH REGULATING VALVES, BRASS FIST INDICATORS, AND DEFLECTING SHIELDS TO PREVENT THE WALLS FROM BEING DISCOLORED, ALSO AIR FILTERS WHEN REQUIRED. THESE TUBES ARE SO CONSTRUCTED THAT DUST CANNOT LODGE OR ACCUMULATE IN THEM. CAN BE FITTED WITH AIR WARMERS. —SEE PAGE 137.



PRICE LIST

	N ^o 233.	N ^o 234.	N ^o 235.	N ^o 236.	N ^o 237.
5 ft. 9 in. X 8 in. X 3 in.	£0 16 6.	£1 1 6.	£1 5 0.	£1 7 6.	£1 10 0.
5 „ 9 „ X 9 „ X 4 „	0 18 6.	1 4 0.	1 8 6.	1 11 6.	1 15 0.
5 „ 9 „ X 10 „ X 4½ „	1 1 0.	1 7 0.	1 12 0.	1 15 6.	2 0 0.
5 „ 9 „ X 12 „ X 5 „	1 5 0.	1 12 6.	1 17 6.	2 1 6.	2 6 0.
5 „ 9 „ X 12 „ X 6 „	1 6 6.	1 15 0.	2 2 0.	2 6 6.	2 12 0.

Canvas Air Filters, 6d. to 2s. extra.

NOTE: When employed the Filters should be removed periodically from the Brackets & cleaned with a brush.

Water Troughs to wash, cool, purify or medicate the air 5s 6d to 7s 6d extra.

Open and Shut Indicator, Brass Letters and Pointer, 6d. extra.

Enamel Plate, 1s. extra.

INSTRUCTIONS FOR FIXING.

In fixing the Tubes, say of the size 5' 9" x 10" x 4½" holes should be cut through the walls 9" x 9" on the outside tapering upwards (as shown in section) to 8" x 8" on the inside, smoothly lined with cement & protected with open pattern cast-iron or other gratings. The Tubes are screwed to the walls at the top, the bottom slip being embedded in the cement lining. One inch margin round slip covers joint in wall so that no touching up is required.

N.B. When specifying or ordering the following formula should be used: "BOYLE'S Air-Inlet Tube, Design No. Size, No required, Price each" If to be fitted with special Indicator, Filter, or Water Trough, please state so.

NOTE. — Each Tube has the accompanying Trade Mark affixed, without which none are genuine.

BOYLE'S AIR INLET



Section.

BOYLE'S AIR-INLET TUBES.

ORNAMENTAL DESIGNS.
CAN BE MADE TO ARCHITECTS' OWN DESIGNS.
Prices quoted.



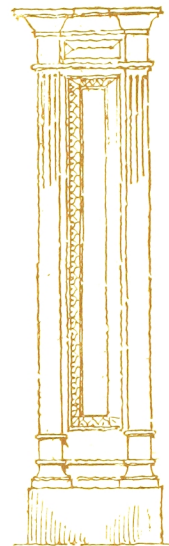
No. 238



No. 239



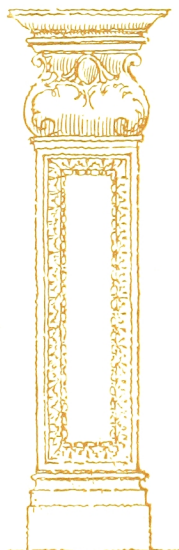
No. 240



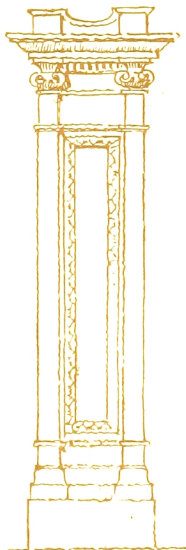
No. 241



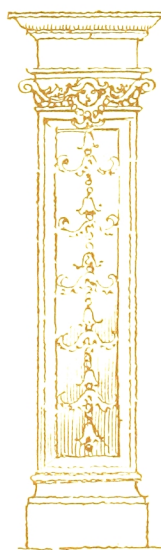
No. 242



No. 243



No. 244



No. 244^A



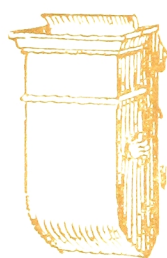
No. 244^B



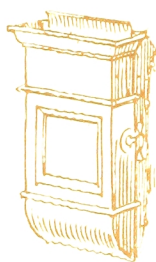
No. 244^C

BOYLE'S AIR-INLET BRACKETS.

FITTED WITH REGULATING VALVES, BRASS FIST INDICATORS, AND DEFLECTING SHIELDS TO PREVENT THE WALLS FROM BEING DISCOLORED, ALSO AIR FILTERS WHEN REQUIRED. THESE BRACKETS ARE SO CONSTRUCTED THAT DUST CANNOT LODGE OR ACCUMULATE IN THEM.  CAN BE FITTED WITH AIR WARMERS. —SEE PAGE 137.



No 245



No 246



No 247



No 248



No 249

PRICE LIST



Section.

N ^o 245.				N ^o 246.				N ^o 247.				N ^o 248.				N ^o 249.			
Ins.	£	s.	d.	£	s.	d.	£	s.	d.	Ins.	£	s.	d.	Ins.	£	s.	d.		
18 × 8 × 3.	0	7	6.	0	8	6.	0	10	6.	18 × 6 × 6.	0	13	6.	20 × 8 × 3.	0	18	6.		
18 × 9 × 3½.	0	9	0.	0	10	6.	0	12	6.	18 × 6½ × 6½.	0	15	0.	20 × 9 × 3½.	1	0	0.		
20 × 10 × 4.	0	10	6.	0	12	6.	0	14	6.	20 × 7½ × 7½.	0	17	6.	23 × 10 × 4.	1	2	6.		
24 × 12 × 5.	0	15	0.	0	17	6.	0	19	6.	24 × 8½ × 8½.	1	2	6.	27 × 12 × 5.	1	7	6.		
24 × 12 × 6.	0	16	6.	0	18	6.	1	1	0.	24 × 10 × 10.	1	6	0.	28 × 12 × 6.	1	10	0.		

Canvas Air Filters, 6d. to 2s. extra.

NOTE: When employed the Filters should be removed periodically from the Tubes and cleaned with a brush. 

Water Troughs to wash, cool, purify or medicate the air 5s 6d. to 7s 6d. extra.

Open and Shut Indicator, Brass Letters and Pointer, 6d. extra.

" " " Enamel Plate, 1s extra.

INSTRUCTIONS FOR FIXING.

In fixing the Brackets, say of the size 20"x10"x4", holes should be cut through the walls 9"x9" on the outside, tapering upwards (as shown in section) to 8"x8" on the inside 4' 2" above floor level, smoothly lined with cement, and protected with open pattern cast-iron or other gratings. The Brackets are screwed to the wall at the top, the bottom slip being embedded in the cement lining.  One inch margin round slip covers joint in wall so that no touching up is required.

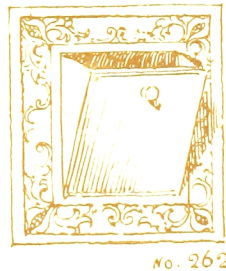
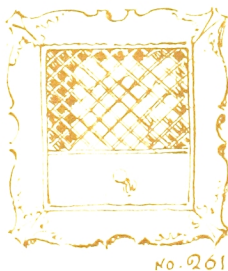
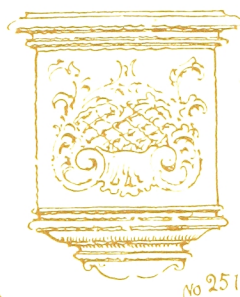
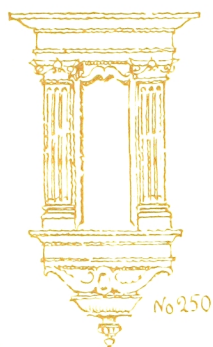
N.B.—When specifying or ordering the following formula should be used "BOYLE'S Air-Inlet Bracket, Design No., Size....., No required....., Price each.....". If to be fitted with special Indicator, Filter, or Water Trough, please state so

NOTE.—Each Bracket has the accompanying Trade Mark affixed, without which none are genuine. 

BOYLE'S AIR INLET

BOYLE'S AIR-INLET BRACKETS & PANELS.

ORNAMENTAL DESIGNS.
CAN BE MADE TO ARCHITECTS' OWN DESIGNS.
Prices quoted.



BOYLE'S AIR-INLET PANELS.

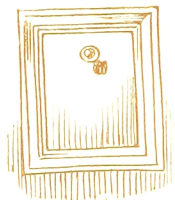
TO FIT FLUSH WITH WALL. FITTED WITH REGULATING VALVES, ALSO AIR FILTERS WHEN REQUIRED.



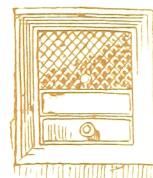
No. 255.



Section.



No. 256.



No. 259.



No. 257.



Section.



No. 258.



Section of No. 259.

PRICE LIST

Ins.	No. 255.	No. 256.	Ins.	No. 257.	No. 258.
9 x 7 x 6.	£0 8 6.	£0 9 6.	10 x 6 x 8.	£0 8 6.	£0 9 6.
10 x 8 x 7.	0 10 6.	0 12 0.	10 x 8 x 8.	0 10 6.	0 12 0.
11 x 9 x 8.	0 12 0.	0 14 0.	10 x 10 x 8.	0 12 0.	0 14 0.
12 x 10 x 9.	0 14 6.	0 18 0.	10 x 12 x 8.	0 14 6.	0 18 0.

Air Filters 1s. extra

NOTE. When employed the Filters should be removed periodically from the Panels and cleaned with a brush. Water Troughs to wash, cool & purify or disinfect the air, can be fitted to the Panels as shewn on design No. 259 & section, at from 5s. to 7s. 6d. extra.

INSTRUCTIONS FOR FIXING.

In fixing the Panels holes should be cut through the walls of same dimensions as the Panels the top of which should be 6ft. above the level of the floor line. These holes should be protected on the outside with cast-iron or other open pattern gratings and lined with cement into which the panel is embedded & screwed against the wall. The margin round panel covers joint in wall so that no touching up is required.

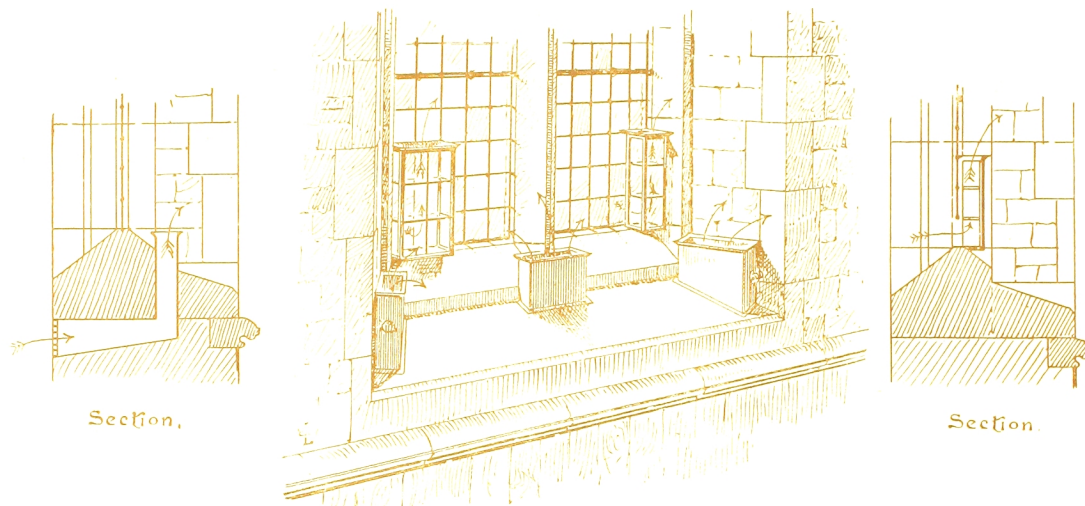
N.B. When specifying or ordering the following formula should be used: "BOYLE'S Air-Inlet Panel, Design No., Size, No required, Price each; If to be fitted with Filters, please state so.

NOTE. Each Panel has the accompanying Trade Mark affixed, without which none are genuine.

BOYLE'S AIR INLET

BOYLE'S AIR-INLET TUBES. FOR FITTING TO WINDOW SILLS.

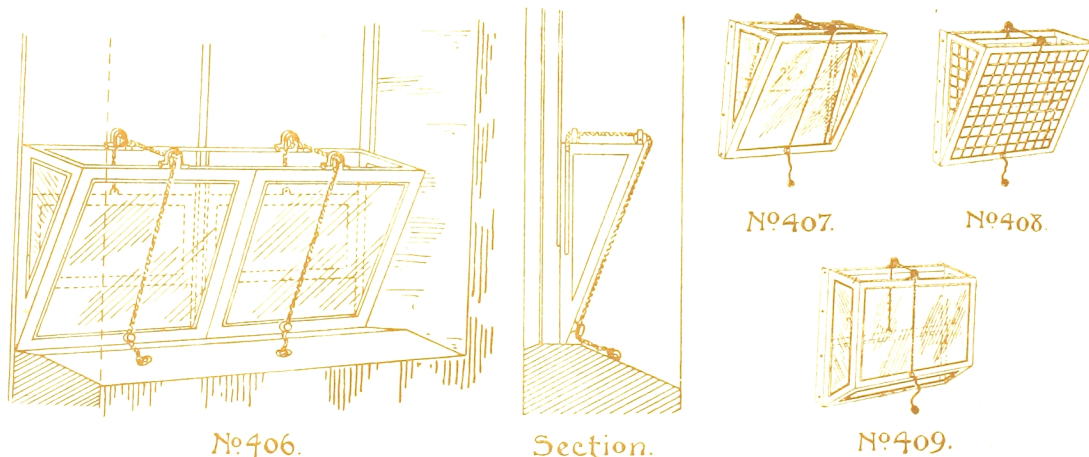
THESE TUBES ARE USUALLY EMPLOYED WHERE THERE IS AN OBJECTION TO HOLES BEING MADE THROUGH THE WALLS.



Nº401. Nº402. Nº403. Nº404. Nº405.

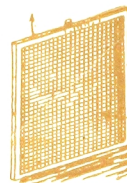
BOYLE'S AIR-INLET WINDOW HOPPERS.

WINDOW HOPPERS SHOULD BE FITTED AT THE LOWER PART OF A WINDOW, NOT THE UPPER, AS IS USUALLY DONE, WHEN A DOWNDRAUGHT GENERALLY RESULTS.



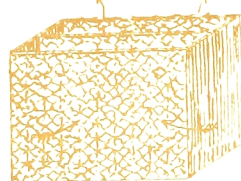
Prices quoted.

No. 480.



Brass Air Filter
for Inlet Panel

Cotton Wool
Air Filter.



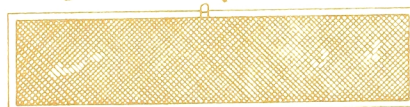
No. 481

Canvas Air Filter
for Inlet Tube.



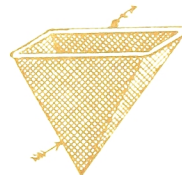
No. 482

Canvas Air Screen
for Ventilating Radiator.



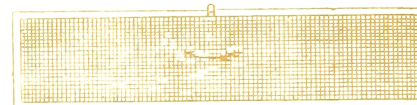
No. 483

Canvas Air Filter
for Inlet Bracket



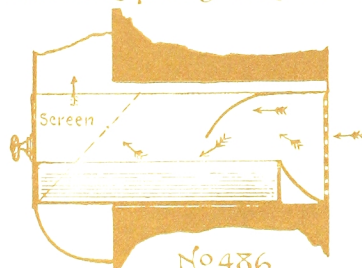
No. 484

Brass or Copper Wire Air Screen
for Ventilating Radiator.



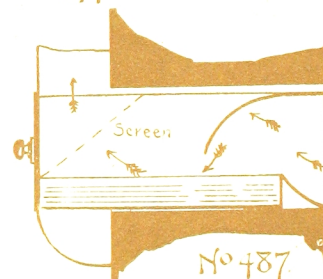
No. 485

Water Trough for Bracket
or Tube fitted with
Canvas Capillary Water Screen



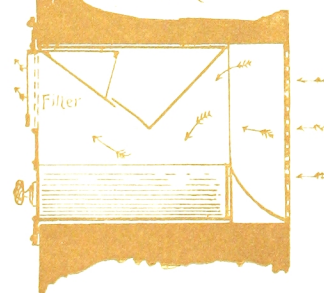
No. 486

Water Trough for Bracket
or Tube fitted with
Copper Wire Screen.

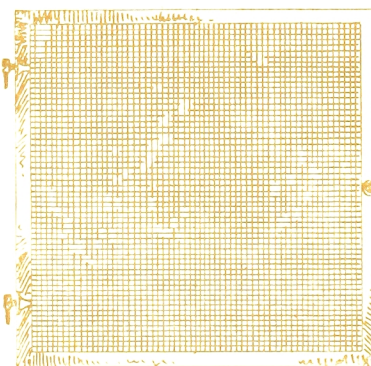


No. 487

Water Trough for
Air Inlet Panel



No. 489



No. 488

Copper wire Air Screen
for large Air Inlet
Channel. This Screen
is fitted with hinges, as
is also the external
grating for giving access
to the Air Channel for
cleansing purposes

Ice Filter
for Washing & Cooling
the Air.



No. 490.

BOYLE'S AIR FILTERS AND SCREENS

FOR PURIFYING & CLEANSING
THE FRESH AIR SUPPLY &
THESE FILTERS & SCREENS
ARE REMOVABLE AND EASY
OF ACCESS. THEY SHOULD BE
CLEANED PERIODICALLY, THE
DRY FILTERS BEING BRUSHED
AND THE WATER SCREENS
RINSED IN WATER.

Prices quoted.

Air Screens :

Their comparative efficiency with Natural and Mechanical Systems of Ventilation.

"If air is forced rapidly through a screen it cannot fail to carry dust with it."—SIR DOUGLAS GALTON, F.R.S.

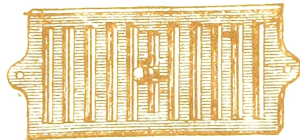
"There are many different contrivances in use for washing, screening, and purifying the air, the majority of which answer their purpose fairly well, though the evidence would seem to indicate that they are found to be most effective when employed in conjunction with a natural system of ventilation where the air is not mechanically propelled, but is drawn through by extraction, the air being more thoroughly purified moving in at a *low* velocity than when forced in under pressure.

. . . "The Metropolitan Asylums Board employ a natural system of ventilation by extraction from the ceiling, and admission of air from below, —the plan approved by the Local Government Board. . . . The purity and freshness of the air in the wards, especially in the more recent hospitals, is remarkable.

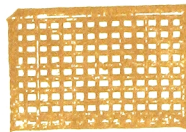
. . . "The fresh air supply is screened and purified and the temperature can be regulated as required. No fog or other impurities in the external air ever find access to the wards, the atmosphere of which is perfectly clear and bright even during a dense fog."—*Local Government Journal*.

"A close examination of, and several tests which we applied to, the system of ventilation (mechanical) at the Victoria General Infirmary (Glasgow) convince us that, whereas the main duct is kept comparatively free from grit and dust, the small ducts communicating directly with the wards have not been protected against the intrusion of these deleterious matters. Indeed, the evidence shows that with the air very much enters that should be excluded from the wards, as the walls and ceilings eloquently testify. We are of the opinion that the method of washing the air is imperfect, and might be improved. This would tend to minimise the amount of dust and blacks which at present find their way into the wards."—"*Hospitals and Asylums of the World*," 1893 (SIR HENRY BURDETT).

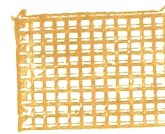
AIR-INLET GRATINGS. CAST-IRON.



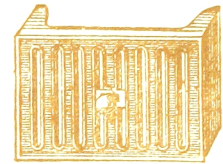
No. 440.
9 × 6 ins. 12 × 6 ins.
9½ × 9 " 12 × 9 "



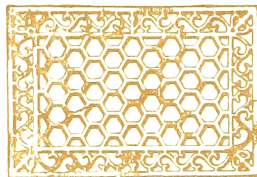
No. 441.
9 × 6 ins. 12 × 12 ins.
9 × 9 " 14 × 9 "
18 × 9 ins.



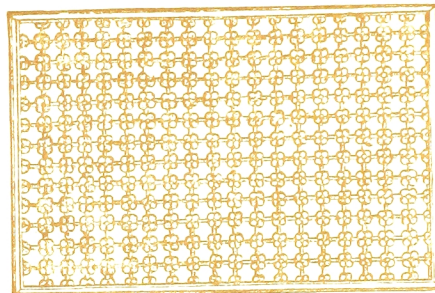
No. 442.
9 × 6 ins. 12 × 12 ins.
9 × 9 " 14 × 9 "
12 × 9 " 18 × 9 "



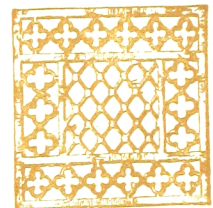
No. 443.
9 × 6 ins.
12 × 6 ins.
14 × 9 ins.



No. 444.
8 × 8 ins. 12 × 6 ins.
9 × 6 " 12 × 12 "
9 × 9 " 14 × 12 "



No. 445.
9 × 9 ins. 10 × 10 ins. 12 × 12 ins. 14 × 9 ins.



No. 446.
9 × 9 ins.
12 × 12 "



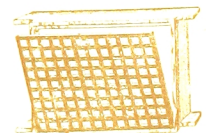
No. 447.
8 × 12 ins.
9½ × 11½ "



No. 448.
12 × 9 in. 18 × 18 ins.
*15 × 15 " 21 × 21 "
*Plain border only.

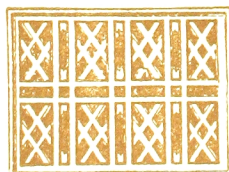


No. 449.
9 × 6 ins. 12 × 9 ins.
12 × 6 " 18 × 6 "

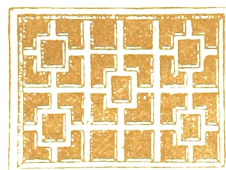


No. 450.
9 × 9 ins.
12 × 9 "

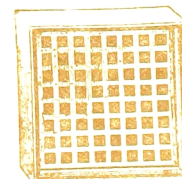
TERRA-COTTA.



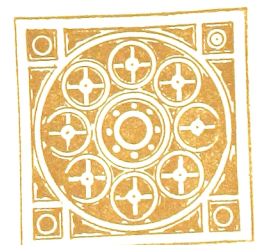
No. 460.
9 × 9 ins.
12 × 9 "



No. 461.
9 × 6 ins.
12 × 9 "



No. 462.
9 × 9 ins.
12 × 12 "



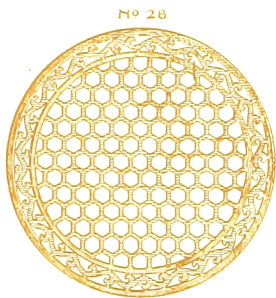
No. 463.
10 × 10 ins

Prices quoted.

VENTILATING CENTRE FLOWERS AND CEILING PANELS.

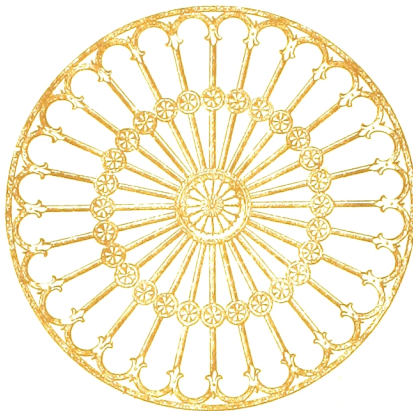
CAST-IRON.

Nº 1759.



Nº 28

18 - 30 ins.



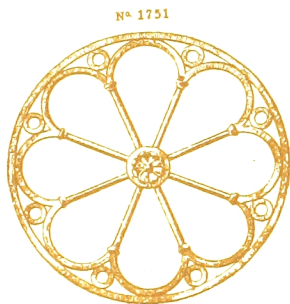
Nº 1744

4' 4"



Nº 1755

2' 0"



Nº 1751

2' 3"



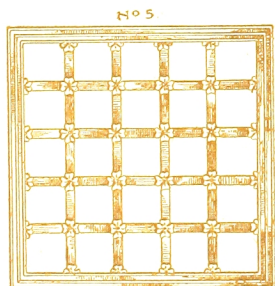
3' 2"



Nº 1767

2' 0"

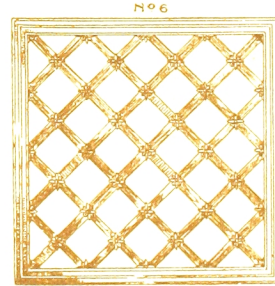
ZINC and STEEL.



Nº 5



Nº 7



Nº 6

PRICES QUOTED.

LORD CLIFFORD

(MEMBER OF THE
HOUSE OF LORDS COM-
MITTEE ON HOSPITALS).

"The Ventilation [on
the 'Boyle' System]
seems to be perfect"
(See page 50.)



THE RIGHT HONOURABLE
C. SEALE-HAYNE, M.P.
(LATE PAYMASTER GENERAL)

"I believe it [the Boyle
System of Ventilation]
to be absolutely the best
system of airing a public
building that is known
to sanitary science."



BOYLE'S PATENT
AND
LATEST IMPROVED
FRESH AIR WARMING
AND
HEATING APPLIANCES.

PART VI.

"Heating should be done by means of radiant heat, and not by means of air previously warmed."— PROFESSOR CORFIELD.

UNHEALTHINESS OF HOT AIR HEATING.

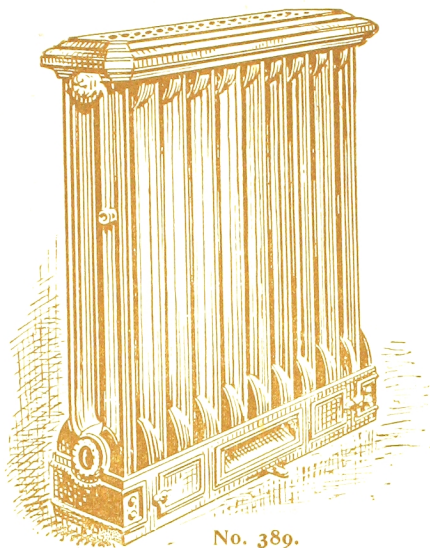
"The method of warming the walls by means of heated air necessarily leaves the walls colder than the air of the room, and the heat of the body is radiated to the colder walls. Hence, if the walls are to be warmed by the air admitted to the room, the temperature of the warmed air must be raised beyond what is either comfortable or healthy for breathing, & thus, if you obtain your heat by warmed air alone admitted direct to the room, discomfort in one form or the other can with difficulty be avoided." —

SIR DOUGLAS GALTON, F.R.S.

DANGER OF A HOT AIR SUPPLY.

"Heating should be done by means of radiant heat, and not by means of air previously warmed. If air was previously warmed it would lose a portion of its oxygen, and if we got air short of oxygen, we had to breathe a greater number of times to supply the required amount and that meant more effort." —

PROFESSOR CORFIELD
(Professor of Hygiene and
Public Health, London University)



No. 389.

BOYLE'S VENTILATING RADIATOR

PRICE LIST

34½ Inches High.
4½ Square Feet per Section.

The fresh air supply is admitted through the Radiators warmed to a temperature which does not in any way deteriorate it, as is the case with furnace heating when hot air only is employed for heating as well as ventilation purposes.

Full area of heating surfaces guaranteed. All tested to a pressure of 100 lbs.

The Radiator is connected with Right and Left hand threaded nipples.

Each Section is 7 inches wide.

Height from floor to centre of opening is about 5 inches. The Radiator is tapped 1½ inches, and bushed in accordance with our Standard List unless ordered otherwise. In estimating length of Radiator, allow ½ inch for each bushing.

This Radiator is fitted with our improved Ventilating Base for semi-direct heating. The Air Inlet can be brought up underneath Radiator through floor, or brought in at back of Radiator, above floor level. In ordering, state whether required for bottom or back inlet.

Outside measurements of flange or lip around back air inlet of Ventilating Base, for attaching sheet-iron sleeve or pipe, are:

Base.	Inches.	Base.	Inches.
12-section ...	24¾ × 3	7-section ...	13¾ × 3
11-section ...	21½ × 3	6-section ...	8¾ × 3
10-section ...	18¾ × 3	5-section ...	8¾ × 3
9-section ...	15¾ × 3	4-section ...	6 × 3
8-section ...	15 × 3	3-section ...	3½ × 3

Bottom of back air inlet opening is ¾ of an inch above floor level.

Where Air Conduit is brought up through floor, under Radiator, the opening in floor to be covered by dampers in Base should be:

Base.	Inches.	Base.	Inches.
12-section ...	24 × 4½	7-section ...	14¼ × 4½
11-section ...	21½ × 4½	6-section ...	8¼ × 4½
10-section ...	18 × 4½	5-section ...	8¼ × 4½
9-section ...	18 × 4½	4-section ...	5½ × 4½
8-section ...	14¼ × 4½	3-section ...	5½ × 4½

NOTE.—Radiators larger than 12 sections will have the same size air inlet as a 12-section; the Ventilating Base, however, will extend the entire length of Radiator.

The Radiator is also supplied without Ventilating Base.

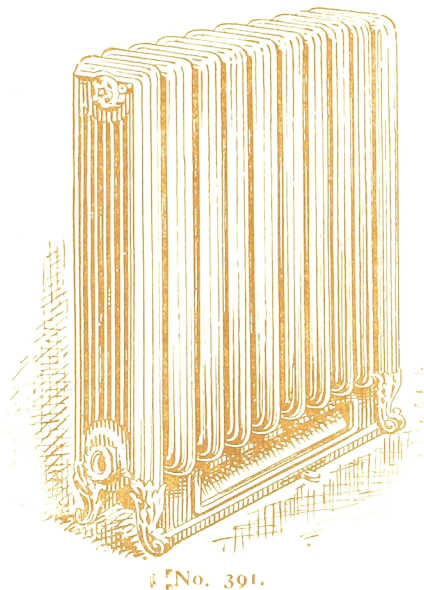
Number of Sections.	Length in Inches.	Heating Surface. sq. ft.	No. 389.
			£ s. d.
2	6	9	1 5 4
3	9	13½	1 18 0
4	12	18	2 10 8
5	15	22½	3 3 4
6	18	27	3 16 0
7	21	31½	4 8 8
8	24	36	5 1 4
9	27	40½	5 14 0
10	30	45	6 6 8
11	33	49½	6 19 4
12	36	54	7 12 0
13	39	58½	8 4 8
14	42	63	8 17 4
15	45	67½	9 10 0
16	48	72	10 2 8
17	51	76½	10 15 4
18	54	81	11 8 0
19	57	85½	12 0 8
20	60	90	12 13 4

Without Ventilating Base 2/3 per Section less.

Without Ornamental Top 8d. per Section less.

Other designs of Ventilating and Heating Radiators may be had on application

BOYLE'S VENTILATING RADIATOR



The fresh air supply is admitted through the Radiator warmed to a temperature which does not in any way deteriorate it, as is the case with furnace heating, when hot air only is employed for heating as well as ventilation purposes.

It ensures the highest efficiency in the most compact form.

Principle of Construction of Base is such that all the air required for ventilation may be taken from without the building by means of Air Conduit in wall, and distributed through Base into the interior or flue surface of Radiator. When out-door temperature is very low, dampers in Base may be adjusted to any smaller air capacity desired, regulating exactly the heating and ventilating requirements of the room; or, dampers may be entirely closed, the Radiator then acting wholly as a direct radiator.

Leading Features of the Box Base are simplicity of construction, ease of operation, capacity for ample supply of air. Base being wholly under the Radiator, well recessed, is entirely out of the way and not liable to damage. Front of Base, including dampers, may easily be removed for cleaning purposes. Dampers may be operated merely by slight pressure of the foot.

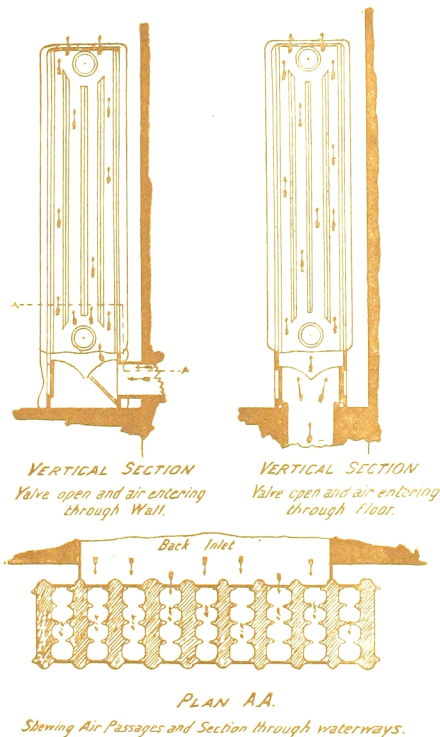
Air Conduit. The sections show views of Radiator and Box Base, with Air Conduit brought up underneath Radiator, through floor or in at back of Radiator, above floor level. In this latter method it is necessary to use a galvanized or sheet-iron sleeve to make connection between flange or collar cast around back air inlet of Base, and a similar collar on back of wall box.

Outside measurements of flange or lip around back air inlet of Ventilating Base, for attaching sheet-iron sleeve or pipe, are:

Base.	Inches.	Base.	Inches.
12-section ...	$24\frac{1}{4} \times 3\frac{1}{4}$	7-section ...	$11\frac{7}{8} \times 3\frac{1}{4}$
11-section ...	$21\frac{1}{4} \times 3\frac{1}{4}$	6-section ...	$9 \times 3\frac{1}{4}$
10-section ...	$18\frac{1}{4} \times 3\frac{1}{4}$	5-section ...	$5\frac{1}{2} \times 3\frac{7}{8}$
9-section ...	$15\frac{1}{4} \times 3\frac{1}{4}$	4-section ...	$5\frac{3}{8} \times 3\frac{1}{4}$
8-section ...	$14\frac{1}{4} \times 3\frac{1}{4}$	3-section ...	$2\frac{3}{4} \times 3\frac{1}{4}$

Where Air Conduit is brought up through floor, under Radiator, the opening in floor to be covered by dampers in Base should be:

Base.	Inches.	Base.	Inches.
12-section ...	$24\frac{1}{8} \times 3\frac{7}{8}$	7-section ...	$11\frac{5}{8} \times 3\frac{5}{8}$
11-section ...	$21\frac{1}{8} \times 3\frac{7}{8}$	6-section ...	$8\frac{1}{2} \times 3\frac{5}{8}$
10-section ...	$18 \times 3\frac{5}{8}$	5-section ...	$6\frac{1}{8} \times 3\frac{1}{2}$
9-section ...	$15\frac{1}{8} \times 3\frac{7}{8}$	4-section ...	$5\frac{1}{2} \times 3\frac{1}{2}$
8-section ...	$14\frac{3}{8} \times 3\frac{7}{8}$	3-section ...	$3\frac{1}{4} \times 3\frac{1}{2}$



Other designs of Ventilating and Heating Radiators may be had on application.

BOYLE'S VENTILATING RADIATOR

REGISTERED DESIGN.

DIMENSIONS AND PRICES.

Number of Sections.	Length in Inches.	39½ Inches High. 7 Sq. Feet per Section.			33½ Inches High. 5½ Sq. Feet per Section.			27½ Inches High. 4½ Sq. Feet per Section.			21½ Inches High. 3½ Sq. Feet per Section.		
		Heating Surface.	No. 391.			Heating Surface.	No. 391.			Heating Surface.	No. 391.		
		Sq. Ft.	£	s.	d.	Sq. Ft.	£	s.	d.	Sq. Ft.	£	s.	d.
2	6	14	1	12	6	11½	1	9	5	9	1	5	6
3	9	21	2	8	9	17¼	2	4	2	13½	1	18	3
4	12	28	3	5	0	23	2	18	10	18	2	11	0
5	15	35	4	1	3	28¾	3	13	7	22½	3	3	9
6	18	42	4	17	6	34½	4	8	3	27	3	16	6
7	21	49	5	13	9	40¼	5	3	0	31½	4	9	3
8	24	56	6	10	0	46	5	17	8	36	5	2	0
9	27	63	7	6	3	51¾	6	12	3	40½	5	14	9
10	30	70	8	2	6	57½	7	7	1	45	6	7	6
11	33	77	8	18	9	63¼	8	1	10	49½	7	3	0
12	36	84	9	15	0	69	8	16	6	54	7	13	0
13	39	91	10	11	3	74¾	9	11	3	58½	8	5	9
14	42	98	11	7	6	80½	10	5	11	63	8	18	6
15	45	105	12	3	9	86¼	10	19	8	67½	9	11	3
16	48	112	13	0	0	92	11	15	4	72	10	4	0
17	51	119	13	16	3	97¾	12	10	1	76½	10	16	9
18	54	126	14	12	6	103½	13	4	9	81	11	7	3
19	57	133	15	8	9	109¼	13	19	6	85½	12	2	3
20	60	140	16	5	0	115	14	14	2	90	12	15	0
21	63	147	17	1	3	120¾	15	8	11	94½	13	7	9
22	66	154	17	17	6	126½	16	3	7	99	14	0	6
23	69	161	18	13	9	132¼	16	18	4	103½	14	12	3
24	72	168	19	10	0	138	17	13	0	108	15	6	0
25	75	175	20	6	3	143¾	18	7	9	112½	15	18	9

Height	...	...	...	...	39½ Inches.	33½ Inches.	27½ Inches.	21½ Inches.
Price per Section...	...	...	...	...	16s. 3d.	14s. 9d.	12s. 9d.	10s. 11d.

This Radiator is also supplied without Ventilating Base.

PRICE 2s. 3d. PER SECTION LESS.

Full area of heating surfaces guaranteed. All tested to a pressure of 100 lbs.

The Radiator is connected with Right and Left hand threaded nipples.

Each Section is 8½ inches wide.

Height from floor to centre of opening is about 6 inches. The Radiator is tapped 2 inches and bushed in accordance with our standard list unless ordered otherwise. In estimating length of Radiator allow half an inch for each bushing.

BOYLE'S VENTILATING GRATE

Prices quoted.

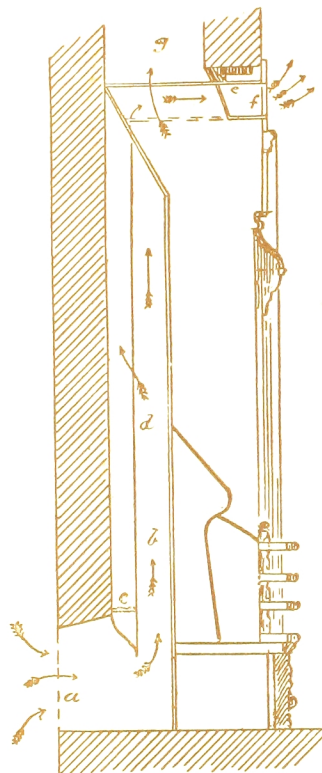


FIG. 1.

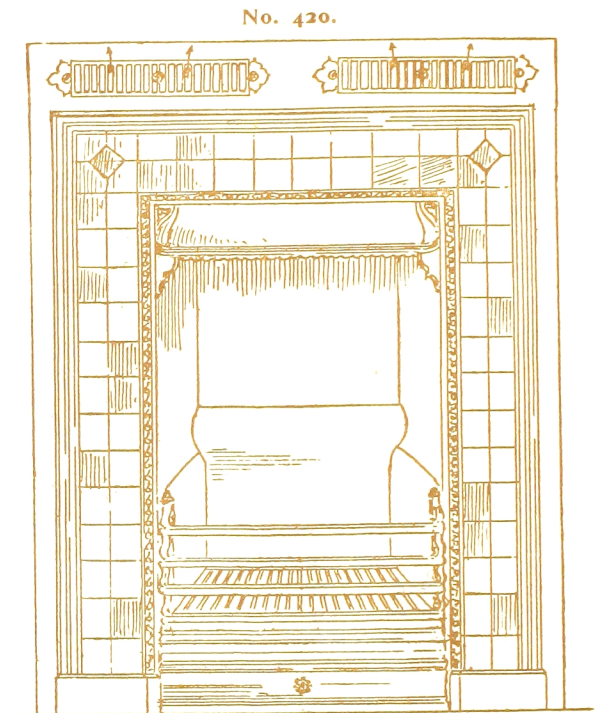


FIG. 2.

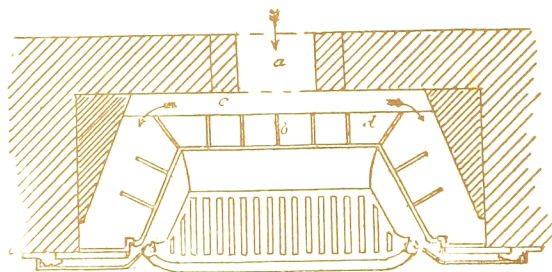


FIG. 3.

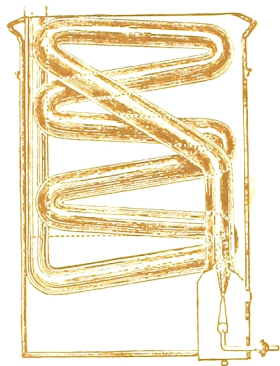
This Grate is arranged to admit a supply of fresh air, filtered and warmed to a comfortable temperature, but not to such a degree as to in any way injure the quality of the air for respiratory purposes.

FIG. 1.—A. Opening through external wall to admit fresh air. B. Gills for warming the fresh air. C. Stop plate to direct the air between the gills. D. Warm air chamber. E. Top of warming chamber. F. Fresh air inlet to room fitted with movable air filter and regulator. G. Smoke flue.

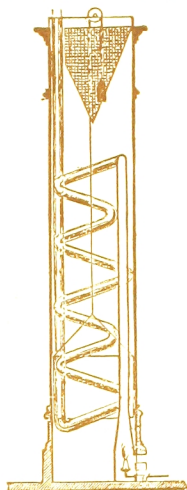
FIG. 2.—Elevation of Grate.

FIG. 3.—Plan of Grate.

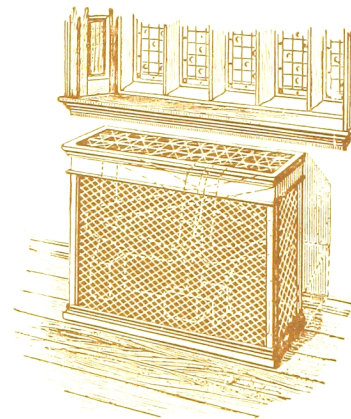
BOYLE'S FRESH AIR WARMING TUBES, BRACKETS, AND CHAMBERS.



BRACKET.
No. 430.



TUBE.
No. 431.



CHAMBER.
No. 432.

These appliances are intended for warming the fresh-air supply to a building by means of an atmospheric or an ordinary gas burner. The arrangement consists of a copper pipe about 2-in. diameter, placed in an inlet Bracket, Tube or Chamber. This pipe is of zigzag shape, causing the incoming air to repeatedly impinge upon it. At the bottom of the Bracket, Tube or Chamber, a cylinder is fixed, in which the burner is placed to heat the copper pipe. The temperature of the incoming air may be regulated as required without the deteriorating effects of furnace heating which results when hot air only is employed for heating as well as for ventilation purposes. The products of combustion do not come into contact or mix with the incoming air.

When available hot water or steam pipes may be fitted into the Bracket, Tube or Chamber.

PRICE LIST

Made in Galvanized Steel, Painted, and fitted with Copper Pipes and Regulating Valves.

BRACKETS.						No. 430.
22 ins. by 14 ins. by 5 ins.	...	...	...	...	...	£3 10 0
24 " " 16 " " 6 "	...	...	...	...	...	4 5 0
26 " " 18 " " 6 "	...	...	...	...	...	5 0 0
TUBES.						No. 431.
5 feet 9 ins. by 10 ins. by 5 ins.	...	...	...	...	...	£3 10 0
5 " 9 " " 12 " " 6 "	...	...	...	...	...	4 5 0
5 " 9 " " 14 " " 6 "	...	...	...	...	...	5 0 0

Fitted with Water Troughs 10s. to 20s. extra, Air Filters 5s. to 10s. extra.

CHAMBERS.		No. 432.	Ornamental Wire Casing, extra.
24 ins. by 24 ins. by 6 ins.	Single Burner ...	£5 10 0	£1 0 0
30 " " 24 " " 6 "	Double " .	7 0 0	1 5 0

Fitted with Filters 7s. 6d. to 15s. extra.

"The name of BOYLE in connection with Ventilation is a household word throughout the world."—
Building News.

"Experiments seem to have demonstrated the perfect success of Mess^{rs}. BOYLE'S 'work'." — *Builder.*

"The long experience of Mess^{rs}. ROBERT BOYLE & SON, as pioneers of sanitary Ventilation, has taught them to effect the desired end by the simplest of means." — *Architect.*

"The 'Air-Pump' Ventilator creates a continuous upward current." —
Engineer.

"A system of ventilation that appears to meet all requirements is the one invented by Mess^{rs}. Robert BOYLE & SON, the well-known ventilating engineers." — *Engineering.*

"An Invention, which is of national worth — The 'Air-Pump' Ventilator — that invention which has made the name of BOYLE world-famous." —
Sanitary Engineering.

THE "BOYLE" SYSTEM
OF
VENTILATION
AS
APPLIED TO SHIPS
AND
RAILWAY CARRIAGES.

PART VII.

"The efficient Ventilation of Ships means a considerable annual saving in life & money."

ADMIRAL SIR HASTINGS
R. YELVERTON, G.C.B.
FIRST SEA LORD OF
THE ADMIRALTY. &c.

"I have great pleasure in recommending Mr. Boyle as sole inventor of a Ventilator which I found of the greatest use during my three years command in the Mediterranean, on board Her Majesty's ship 'Lord Warden'. Since then Mr. Boyle has fitted a Ventilator to my official residence, 13, New St, Spring Gardens, which answers admirably. I cannot speak too highly of Mr. Boyle's admirable system of Ventilating Ships and Houses."

DR. NANSSEN
ON THE "BOYLE" SYSTEM
OF VENTILATION AS
SUPPLIED TO THE "FRAM"

"I am convinced that your Ventilating System will prove to be of the utmost value in those regions where the ship for years will be our dwelling, and where, of course, good ventilation is *conditio sine qua non* for our health & sanity."

BOYLE'S PATENT "AIR-PUMP" VENTILATORS FOR SHIPS. (LATEST PATENT).

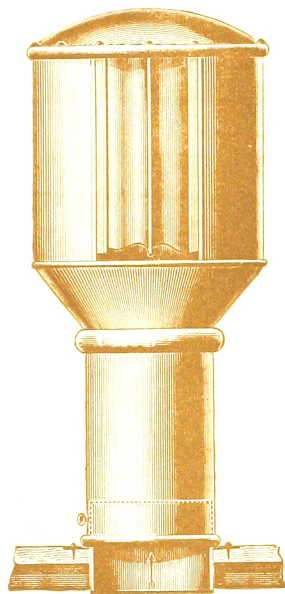


Fig. 10.
Boyle's Patent
"Air-Pump" Ventilator.
(Upcast.)

These Ventilators have double the power of earlier forms, so that smaller Ventilators may now be used, effecting not only a considerable reduction in the cost, but also a saving in space.

They are watertight, and can be kept in action during the stormiest weather.

They are fixtures requiring no trimming or attention.

They are *always* in action.

They have no mechanical movement, and therefore cannot get out of order.

NOTE.—When specifying or ordering, the following formula should be used:—"Boyle's Patent 'Air-Pump' Ventilator (Fig. 10 or 12, upcast or downcast, as required). Diameter of head..... Diameter of pipe..... Over all deck height of ventilator..... Material to be made of..... No. required..... Price, each....."

NOTE.—Boyle's Patent "Air-Pump" Ventilators are manufactured solely by us, and each Ventilator has the accompanying Trade Mark affixed, without which none are genuine.

Beware of Inferior Imitations.



REPORT FROM LORD KELVIN.

"I have seen several different forms of Mr. Boyle's 'Air-Pump' Ventilator in actual operation, and have much pleasure in testifying to their efficiency. They thoroughly realise the favourable anticipations which I formed from experiments on models shown to me by Mr. Boyle. Having one fitted up in my yacht, I find it has caused a very decided improvement in the draught."



Fig. 12.
Boyle's Patent
"Air-Pump" Ventilator
(Downcast.)

PRICE LIST

MADE OF THE BEST ROLLED STEEL PLATES, RIVETTED THROUGHOUT, GALVANIZED AND PAINTED, ALSO BRASS AND COPPER.

Dia. of Head.	Dia. of Pipe.	STEEL. Figs. 10 & 12.	BRASS.* Figs. 10 & 12.	COPPER.* Figs. 10 & 12.
16 in. ...	8 in. to 10 in.	£4 0 0	£7 17 6	£8 15 0
18 " ...	9 " to 11 "	5 5 0	9 15 0	11 0 0
20 " ...	10 " to 12 "	6 15 0	13 10 0	14 10 0
24 " ...	12 " to 14 "	9 0 0	17 10 0	19 10 0
27 " ...	14 " to 16 "	11 0 0	22 0 0	24 10 0
30 " ...	15 " to 17 "	13 0 0	25 10 0	29 10 0
36 " ...	18 " to 21 "	17 10 0	37 0 0	43 10 0
42 " ...	21 " to 24 "	27 10 0	49 10 0	58 0 0
48 " ...	24 " to 28 "	41 10 0	71 0 0	83 0 0

SMALLER SIZES, SPECIALLY MADE FOR YACHTS.

8 in. ...	4 in. to 5 in.	£1 15 0	£3 5 0	£3 15 0
10 " ...	5 " to 6 "	2 5 0	4 0 0	4 10 0
12 " ...	6 " to 7 "	3 0 0	5 10 0	6 6 0
14 " ...	7 " to 8 "	3 10 0	6 10 0	7 10 0
16 " ...	8 " to 10 "	4 0 0	7 17 6	8 15 0

Deck Coamings not included in above Prices.

*N.B.—The Prices of Brass and Copper Ventilators are subject to alteration without notice.

†NOTE.—As the extracting or supply power of a properly constructed Upcast or Downcast Ventilator is solely determined by the size of the head, and not by the diameter of the pipe, the smaller pipe diameters are recommended. They take up less space and cost less.

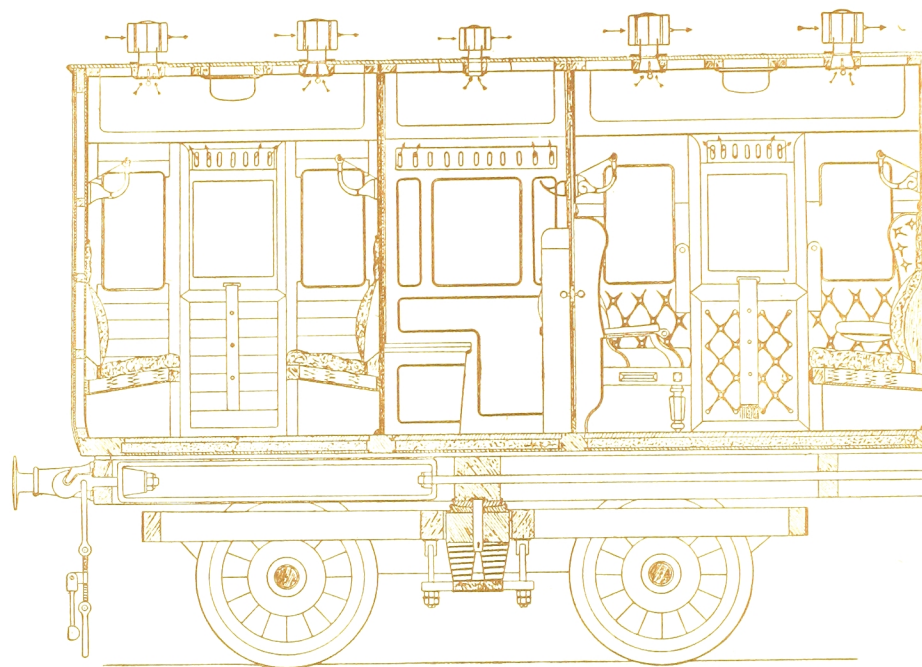
N.B.—When ordering, state depth and outside diameter of coaming at widest part, when the pipe and Ventilator will be made to suit.

The coaming for Fig. 12 should fit the outer cylinder, which is three-fourths the diameter of the head.

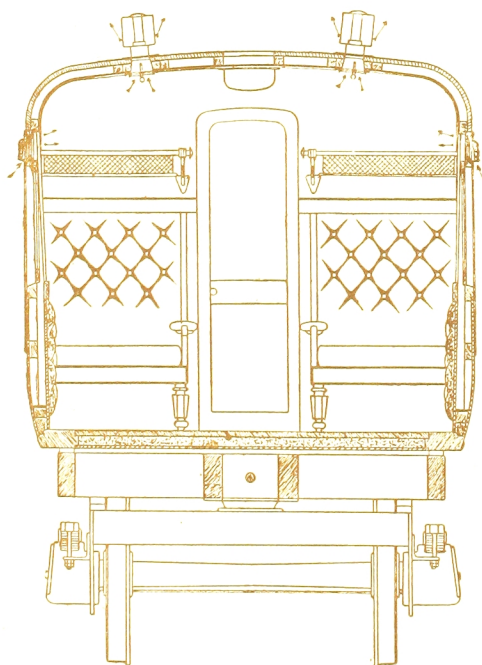
Consulting Naval Engineer—SIR EDWARD J. REED, K.C.B., F.R.S.

Special Catalogue of Ship Ventilators may be had on application.

BOYLE'S PATENT "AIR-PUMP" VENTILATOR AS APPLIED TO A RAILWAY CARRIAGE.



LONGITUDINAL SECTION.



Cross Section Shewing
Boyle's Patent "Air-Pump" Ventilators
fixed transversely on slope of
Carriage roof.



Cross Section shewing
Boyle's Patent "Air-Pump" Ventilator
fixed longitudinally on centre of
Carriage roof.

BOYLE'S PATENT "AIR-PUMP" VENTILATOR

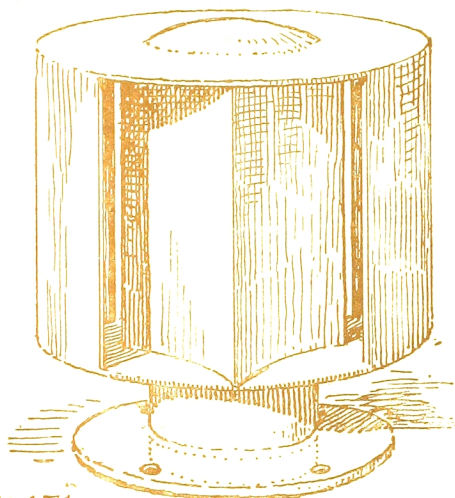
FOR RAILWAY CARRIAGES.

BOYLE'S PATENT "AIR-PUMP" VENTILATOR is guaranteed to be the most powerful exhaust ventilator for Railway Carriages that is at present in existence. It is a fixture, has no mechanical movement, is entirely free from downdraught, and is impervious to rain, snow or sleet.

MADE IN CAST-IRON. PRICES QUOTED.

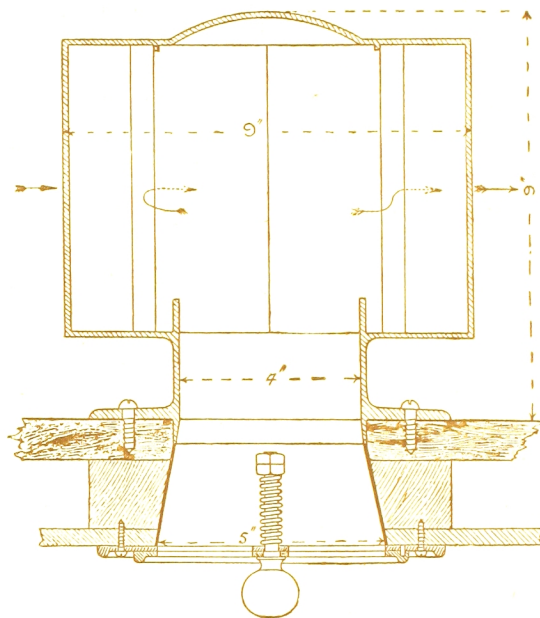
9ins. head. 4ins. dia. pipe. height over all 9ins.

6 " " 2½ " " " " " 6½ "

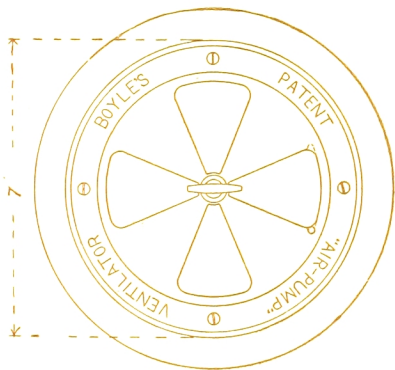


Nº 471.

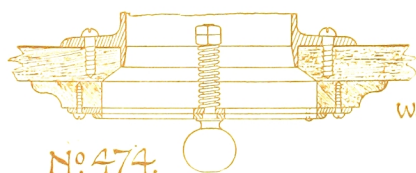
BOYLE'S PATENT "AIR-PUMP"
RAILWAY CARRIAGE VENTILATOR



Longitudinal Section
Shewing Method of fixing

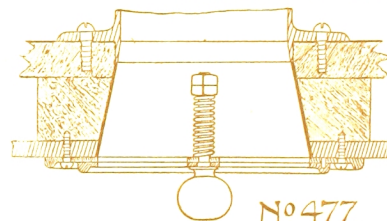


REGULATORS
made in brass
and other metals
Prices quoted.



Nº 474.

Wood moulding



Nº 477.

BOYLE'S THEROLITE

(PATENT) Trade Mark

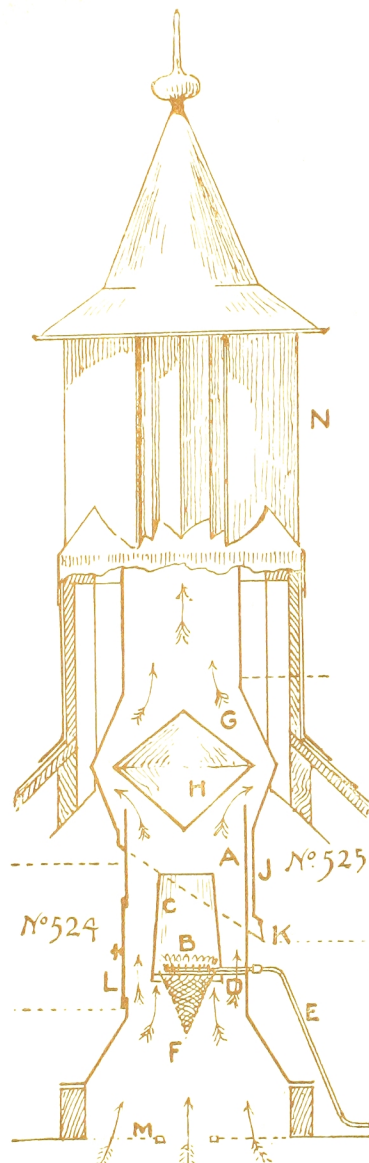
FOR ASSISTING THE UP-DRAUGHT IN SLUGGISH VENTILATING SHAFTS AND FLUES.

The Therolite may be usefully employed in combination with the "Air-Pump" Ventilator for the prevention of condensation and the removal of exhausted steam from Wash-houses, Laundries, Drying Rooms, Breweries, Malt Kilns, &c. It is also of assistance where ventilating shafts or flues are surmounted with ordinary cowls, which fail to create a sufficient up-draught and are subject to down-draught.

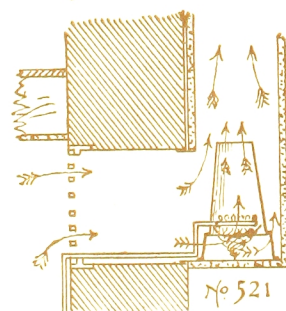
When the "Air-Pump" Ventilator is employed—which creates at all times a powerful and continuous exhaust—the Therolite is unnecessary. Where it is desired, however, to make assurance doubly sure, the Therolite may be used in conjunction with the "Air-Pump" Ventilator—particularly for such buildings as the above-mentioned—as it superheats the cold steam or vapour at the point of exit, and warms the Ventilator and shaft, preventing condensation, and accelerating the exhaust.

Description.

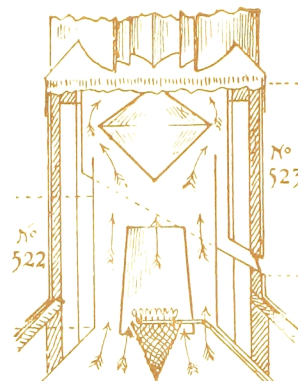
- A Section of shaft of Therolite 2 in. larger than ventilating shaft.
 - B Coil burner of improved construction, giving the maximum of heat with a minimum consumption of gas.
 - C Cone for accelerating the velocity of the hot-air current.
 - D Supporting rods.
 - E Gas pipe.
 - F Flame protector.
 - G Expansion chamber.
 - H Double spreader, for deflecting the heated air on to sides of expansion chamber, and diverting any down current into outer cylinder J, from whence it passes through valve K. The spreader also acts as a calorifer for superheating the up-current and further assisting the exhaust.
 - L Door in shaft giving access to Therolite.
- NOTE.—Where the ceiling is not too high the Therolite may be lighted from below by means of a taper and long rod.
- M Ventilating ceiling panel, with opening in centre, to permit of lighting from below.
 - N Boyle's Patent "Air-Pump" Ventilator, made fireproof.



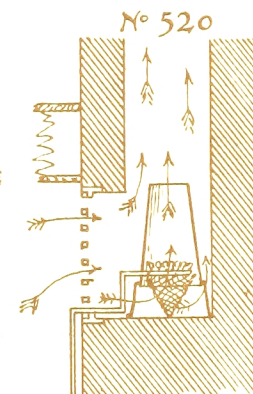
BOYLE'S THEROLITE as fitted to a Ceiled Roof:



BOYLE'S THEROLITE for fitting into External Pipes



BOYLE'S THEROLITE as fitted to an Open Roof. For Wash-houses, Drying-rooms &c. for warming exhausted steam & preventing condensation.



BOYLE'S THEROLITE for fitting into Ventilating Flues

Dia of THEROLITE Pipe.	Dia of Upper Ventilating Pipe.	Nº 520 AND 521 THEROLITE for fitting into flues & external pipes of areas equal to Ventilating pipes	Section. Nº 522 * THEROLITE in Pipe for open roof	Section. Nº 523 Expansion Chamber fitted with Calorifer & down draught Cylinder.	Section. Nº 524 † THEROLITE in pipe fitted With door.	Section. Nº 525 Expansion Chamber fitted With Calorifer & down draught Cylinder.
ins.	ins.					
11	9	£0 18 6	£1 1 0	£1 12 6	£1 3 0	£1 15 0
12	10	1 2 6	1 5 0	1 15 0	1 8 0	1 17 6
14	12	1 10 6	1 12 6	2 0 0	1 16 0	2 5 0
16	14	1 17 6	1 19 0	2 7 6	2 3 0	2 12 6
17	15	2 5 0	2 3 0	2 12 6	2 7 6	3 0 0
20	18	2 15 0	2 12 6	3 5 0	2 17 6	3 12 6
23	21	3 5 0	3 5 0	4 0 0	3 10 0	4 12 6
26	24	3 19 0	3 18 6	5 5 0	4 3 6	5 17 6
30	28	4 18 6	4 15 0	7 0 0	5 0 0	7 15 0

* May be used separately or in conjunction with No. 523.

† " " " " " " No. 525.

BOYLE'S BACTOLITE (PATENT)

FOR DESTROYING
DISEASE GERMS.

The Bactolite is intended for use in small-pox and other infectious diseases hospitals. The disease germs in the air of the hospital are entirely consumed in their passage through the asbestos furnace situated in the roof and connected with the "Air-Pump" Ventilator, so that they do not pass into and contaminate the outer air, spreading infection.

With the "Boyle" system of ventilation, as applied to small-pox hospitals, the air inlets communicate direct with the outer air through specially constructed openings made in the walls fitted with self-acting valves to prevent the air of the hospital from passing by any chance out through these openings.

The incoming air is warmed in cold weather to an agreeable temperature by means of Boyle's Ventilating Radiators without the deterioration and discomfort which results when hot air heating is employed.

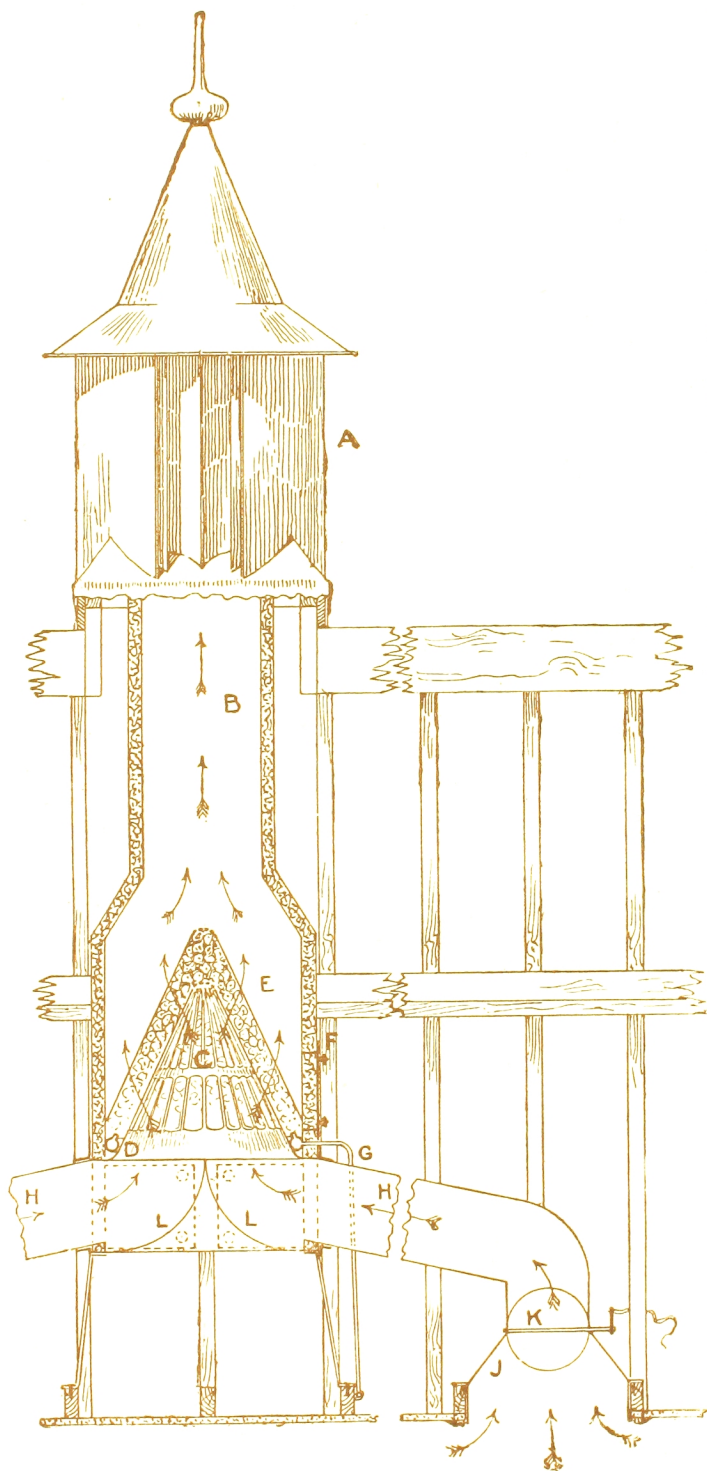
In warm weather the fresh air supply is cooled in its passage through the refrigerating chambers attached to the Radiators, and washed and purified by filtration through saturated and medicated screens.

The outlets and inlets are accessible in all parts for cleansing purposes.

Description.

- A Boyle's Patent "Air-Pump" Ventilator made fireproof.
- B Main extraction shaft with space between packed with non-conducting material.
- C Double grill with space between filled with perforated asbestos balls, through which the disease germs pass and are consumed.
- NOTE.—More than one of these double grills may, where required, be fitted one above the other.
- D Ring of atmospheric burners, the flames from which render the asbestos balls incandescent.
- E Fireproof chamber containing grills.
- F Door giving access to chamber for lighting and other purposes.
- G Gas pipe.
- HH Branch extraction shafts connected with openings in ceiling.
- J Cone covering opening in ceiling.
- K Weighted regulating valve.
- LL Doors giving access to extraction shafts for cleansing purposes.

Estimates Given.



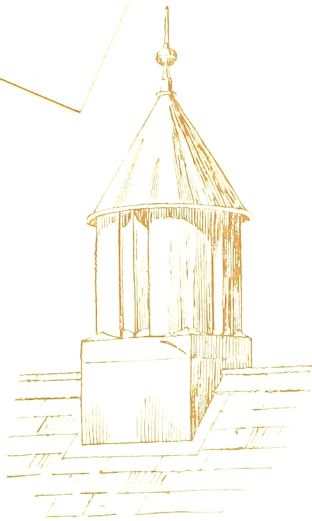
Second Quality Ventilators.

ntilators are supplied to meet the demand for a cheap, reliable Ventilator for Buildings where cost is a primary consideration.

Boyle's Patent "Air-Pump" Ventilators.

2ND QUALITY.

Carriage Paid to any Railway Station in the United Kingdom.



No. 541.

Dia. of Head.	Inside of Base of No 541.	Dia. of Pipe.	Dia. of Pipe Recommended.	Nos. 541 & 541A.
10 ins.	10 x 10 ins.	4 to 6 ins.	5 ins.	£0 15 6.
12 "	12 x 12 "	4 " 8 "	6 "	0 19 6.
14 "	14 x 14 "	5 " 9 "	7 "	1 4 0.
16 "	16 x 16 "	6 " 10 "	8 "	1 16 6.
18 "	18 x 18 "	7 " 11 "	9 "	2 8 6.
20 "	20 x 20 "	8 " 12 "	10 "	3 3 0.
24 "	24 x 24 "	10 " 14 "	12 "	3 19 0.
27 "	27 x 27 "	11 " 16 "	14 "	4 15 0.
30 "	30 x 30 "	12 " 18 "	15 "	5 19 0.
36 "	36 x 36 "	15 " 21 "	18 "	7 19 0.
42 "	42 x 42 "	17 " 24 "	21 "	10 18 6.
48 "	48 x 48 "	20 " 28 "	24 "	13 17 6.
54 "	54 x 54 "	24 " 32 "	28 "	17 17 0.



No. 541A.

For Soil Pipes, Drains and Sewers.



No. 542.

Dia. of Head.	Dia. of Pipe.	Dia. of Pipe Recommended.	Nos. 542. £. s. d.	Dia. of Head.	Dia. of Pipe.	Dia. of Pipe Recommended.	Nos. 542. £. s. d.
6 ins.	2 to 3 ins.	2 ins.	0 7 6.	14 ins.	6 to 7 ins.	6 ins.	1 5 0.
8 "	3 " 4 "	3 "	0 10 6.	16 "	7 " 8 "	7 "	1 15 0.
10 "	4 " 5 "	4 "	0 14 0.	18 "	8 " 9 "	8 "	2 7 0.
12 "	5 " 6 "	5 "	0 18 6.	20 "	9 " 10 "	9 "	3 1 0.

NOTE.—Each Ventilator has the accompanying Trade Mark affixed, without which none are genuine.

BOYLE'S PATENT
'AIR-PUMP' VENTILATOR,
2nd Quality.

N.B.—When specifying or ordering, the following formula should be used:—"Boyle's Patent 'Air-Pump' Ventilator, 2nd Quality, No. Dia. of Head. Dia. of Pipe. No. required. Price, each"

Boyle's Patent "Air-Pump" Ventilator for Soil Pipes

(CHEAP FORM), 2ND QUALITY.

Carriage Paid to any Railway Station in the United Kingdom.



No. 543.

Dia. of Head.	Dia. of Pipe.	Nos. 543. £. s. d.
4 ins.	2 ins.	0 4 6.
6 "	3 "	0 5 6.
8 "	4 "	0 7 6.
10 "	5 "	0 9 6.
12 "	6 "	0 11 6.

NOTE.—Each Ventilator has the accompanying Trade Mark affixed, without which none are genuine.

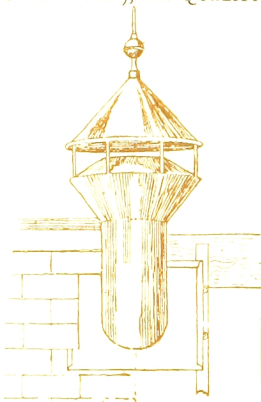
BOYLE'S PATENT
'AIR-PUMP' VENTILATOR
(Cheap Form), 2nd Quality.

N.B.—When specifying or ordering, the following formula should be used:—"Boyle's Patent 'Air-Pump' Ventilator (Cheap Form), 2nd Quality, No. 543. Dia. of Head. Dia. of Pipe. No. required. Price, each"

Second Quality Ventilators.

These Ventilators are supplied to meet the demand for a cheap, reliable Ventilator for Buildings where cost is a primary consideration.

Boyle's Patent "Air-Pump" Ventilator.
(CHEAP FORM), 2ND QUALITY, FOR FACTORIES, STABLES, &c.



Carriage Paid to any Railway Station in the United Kingdom.

NOTE.—Each Ventilator has the accompanying **Trade Mark** affixed, without which **none** are genuine.

BOYLE'S PATENT
'AIR-PUMP' VENTILATOR
(Cheap Form), 2nd Quality.

No. 544.

Dia. of Head. Ins.	Dia. of Pipe. Ins.	Dia. of Pipe Recommended. Ins.	No. 544 £ s. d.	Roof Flanges £ s. d.
12.	6 to 8.	6 ins.	0 15 0.	0 3 3.
14.	7 " 9.	7 "	0 18 6.	0 3 9.
16.	8 " 10.	8 "	1 2 6.	0 4 3.
18.	9 " 11.	9 "	1 7 6.	0 5 0.
20.	10 " 12.	10 "	1 12 6.	0 6 0.
24.	12 " 14.	12 "	2 5 0.	0 7 6.
30.	15 " 18.	15 "	2 19 6.	0 11 6.
36.	18 " 21.	18 "	3 19 6.	0 16 0.
42.	21 " 24.	21 "	5 5 0.	1 6 0.
48.	24 " 27.	24 "	6 15 0.	1 16 0.

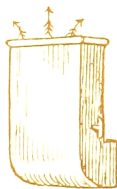
N.B.—When specifying or ordering, the following formula should be used:—"Boyle's Patent 'Air-Pump' Ventilator (Cheap Form), 2nd Quality, No. 544. Dia. of Head..... Dia. of Pipe..... No. required..... Price, each..... Pitch of Roof....."

Boyle's Air Inlet Bracket.

2ND QUALITY.

Fitted with Regulating Valve.

Carriage Paid to any Railway Station in the United Kingdom.



No. 561.

No. 561.			£ s. d.
18 in.	× 8 in.	× 3 in.	0 5 6.
18 "	× 9 "	× 3½ "	0 7 0.
20 "	× 10 "	× 4 "	0 8 0.
24 "	× 12 "	× 5 "	0 12 0.
24 "	× 12 "	× 6 "	0 13 6.

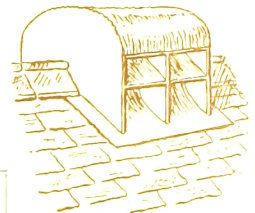
NOTE.—Each Inlet has the accompanying **Trade Mark** affixed, without which **none** are genuine.

BOYLE'S AIR INLET,
2nd Quality.

Boyle's Patent "Air-Pump" Ridge Ventilator.
2ND QUALITY.

Carriage Paid to any Railway Station in the United Kingdom.

NOTE.—Each Ventilator has the accompanying **Trade Mark** affixed, without which **none** are genuine.



No. 545.

Section of			No. 545.
18 ins. diam., A.P.V., per foot run	£ s. d.		15 0.
24 " " " "			1 2 0.
30 " " " "			1 10 0.
36 " " " "			1 17 6.

N.B.—When specifying or ordering, the following formula should be used:—"Boyle's Patent 'Air-Pump' Ridge Ventilator, 2nd Quality, No. 545. Dia..... Length..... Price, per foot..... Pitch of Roof..... Slated or Tiled....."

Boyle's Air Inlet Tube.

2ND QUALITY.

Fitted with Regulating Valve.

Carriage Paid to any Railway Station in the United Kingdom.

No. 549

5 ft. 9 in. × 8 in. × 3 in.	£ s. d.
5 " 9 " × 9 " × 4 "	0 15 0.
5 " 9 " × 10 " × 4½ "	0 17 6.
5 " 9 " × 12 " × 5 "	1 1 0.
5 " 9 " × 12 " × 6 "	1 2 6.

NOTE.—Each Inlet has the accompanying **Trade Mark** affixed, without which **none** are genuine.

BOYLE'S AIR INLET,
2nd Quality.



No. 549.

Boyle's Air Inlet Panel.

2ND QUALITY.

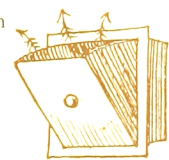
Carriage Paid to any Railway Station in the United Kingdom.

No. 573.

9 in. × 7 in. × 6 in.	£ s. d.
10 " × 8 " × 7 "	0 9 0.
11 " × 9 " × 8 "	0 10 0.
12 " × 10 " × 9 "	0 12 0.

NOTE.—Each Inlet has the accompanying **Trade Mark** affixed, without which **none** are genuine.

BOYLE'S AIR INLET,
2nd Quality.



No. 573.

Table of Approximate Sizes and Number of Boyle's Patent "Air-Pump" Ventilators and Air Inlets Necessary for the Ventilation of different classes of Buildings.

"It is essential to the success of a natural system of ventilation that both the outlet and inlet ventilators be of correct construction and skilfully applied. Where this is not observed failure generally ensues with this form of ventilation."—DE CHAUMONT.

Important.

It having been represented to us by Architects that it would be a great convenience to them, when specifying our Ventilators, if they were provided with a table giving the sizes and number of Outlet and Inlet Ventilators necessary for the ventilation of different buildings, we have now much pleasure in complying with this desire.

We have hitherto refrained from publishing such a table, believing that unscrupulous persons would take advantage of it to issue tables similarly arranged but recommending smaller size or cheaper class Ventilators, with the object of making it appear that a building could be ventilated at a less cost with their arrangements.

We think, however, it is hardly necessary to point out that it is not only the amount that is expended, but also the *results obtained* for that expenditure which have to be considered.

In cases where expense is an important consideration smaller sizes of Ventilators than are here recommended may be employed, but whatever the amount expended we guarantee that the ventilation provided will be more efficient and satisfactory than could be secured by the use of any other arrangements at the same cost, whilst our Ventilators are all substantially made of the best material and of the highest class workmanship, and are intended to last as well as to act.

Robert Boyle & Son, Ltd.

	Accommodation from	Boyle's Patent "Air-Pump" Ventilators.			Boyle's Patent "Air-Pump" Concealed, or Ridge Ventilators.		Boyle's Air Inlets. Middle size.	
Churches & Halls	200 to 300...2	24 in. dia.	12 in. dia.	pipe...2	2 ft. 6 in. lengths	30 in. dia.	sec. 8 to 10	
" "	300 " 400...2	27 in. "	14 in. "	" ...2	3 ft. "	30 in. "	10 " 12	
" "	400 " 500...2	30 in. "	15 in. "	" ...3	2 ft. 6 in. "	30 in. "	12 " 14	
" "	600 " 800...2	36 in. "	18 in. "	" ...3	3 ft. "	36 in. "	16 " 20	
" "	800 " 1000...2	42 in. "	21 in. "	" ...3	3 ft. 6 in. "	36 in. "	20 " 24	
Schoolrooms	... 30 " 50...1	18 in. "	9 in. "	" ...1	2 ft. length	24 in. "	3 " 4	
"	... 50 " 70...1	20 in. "	10 in. "	" ...1	2 ft. 6 in. "	24 in. "	4 " 5	
"	... 70 " 100...1	24 in. "	12 in. "	" ...1	2 ft. 6 in. "	30 in. "	5 " 6	
"	... 100 " 150...2	20 in. "	10 in. "	" ...2	2 ft. lengths	30 in. "	6 " 8	
"	... 150 " 200...2	24 in. "	12 in. "	" ...2	2 ft. 6 in. "	30 in. "	8 " 10	

Prices and Formulas.

For Prices and Formulas to be employed when specifying or ordering, see pages 89, 108, 109, 110, 120, 122, 124.

To Prevent Errors.

When specifying or ordering, the TITLES of the Ventilators should be given IN FULL as well as the Catalogue Numbers.

FOR ADDRESSES SEE PAGES 5 & 152.

(Continued on page 149.)

Table of Sizes, &c.

(Continued).

	Accommodation from	Boyle's Patent "Air-Pump" Ventilators.	Boyle's Patent "Air-Pump" Concealed, or Ridge Ventilators.	Boyle's Air Inlets. Middle size.
Hospital Wards...	2 to 3...1	20 in. dia. 10 in. dia. pipe...1	2 ft. length 30 in. dia. sec. 3 to 4	
" " ...	4 " 5...1	24 in. " 12 in. " ...1	2 ft. 6 in. " 30 in. " 4 " 5	
" " ...	6 " 8...1	30 in. " 15 in. " ...2	2 ft. lengths 30 in. " 6 " 8	
" " ...	9 " 12...2	24 in. " 12 in. " ...2	2 ft. 6 in. " 30 in. " 9 " 12	
" " ...	13 " 16...2	27 in. " 14 in. " ...2	3 ft. " 36 in. " 13 " 16	
" " ...	17 " 20...2	30 in. " 15 in. " ...3	2 ft. 6 in. " 36 in. " 17 " 20	
" " ...	21 " 24...2	36 in. " 18 in. " ...3	3 ft. " 36 in. " 21 " 24	
Council Chambers	30 " 40...1	30 in. " 15 in. " ...1	3 ft. length 36 in. " 4 " 5	
" " ...	40 " 60...1	36 in. " 18 in. " ...1	4 ft. " 36 in. " 6 " 7	
" " ...	60 " 80...1	42 in. " 21 in. " ...2	3 ft. lengths 36 in. " 7 " 9	
" " ...	80 " 110...1	48 in. " 24 in. " ...2	3 ft. 6 in. " 36 in. " 8 " 10	
" " ...	110 " 140...1	54 in. " 28 in. " ...2	4 ft. 6 in. " 36 in. " 10 " 12	
Billiard Rooms ...	1 table ...1	27 in. " 14 in. " ...1	3 ft. length 30 in. " 4	
" " ...	2 tables ...2	24 in. " 12 in. " ...2	2 ft. 6 in. lengths 30 in. " 6 " 8	
Offices ...	4 to 6...1	20 in. " 10 in. " ...	—	2 " 3
" " ...	6 " 8...1	24 in. " 12 in. " ...	—	3 " 4
" " ...	8 " 10...1	27 in. " 14 in. " ...	—	4 " 5
" " ...	10 " 12...1	30 in. " 15 in. " ...	—	5 " 6
Workrooms ...	15 " 20...1	24 in. " 12 in. " ...	—	4 " 5
" " ...	20 " 30...1	27 in. " 14 in. " ...	—	5 " 6
" " ...	30 " 40...1	30 in. " 15 in. " ...	—	6 " 8
Stables for 3 to 4 horses	...1	24 in. " 12 in. " ...	—	3 " 4
" 4 " 7 "	...1	27 in. " 14 in. " ...	—	5 " 6
" 7 " 10 "	...1	30 in. " 15 in. " ...	—	6 " 8
Dining and Drawing Rooms	...1	18 in. " 9 in. " ...	—	2
Sitting Room	...1	16 in. " 8 in. " ...	—	1
Bed Room	...1	12 in. " 6 in. " ...	—	1
W.C. ...	...1	12 in. " 6 in. " ...	—	1

Recommendations for other buildings furnished upon application stating particulars, accompanied by rough sketch where convenient.

NOTE.—When preferred one larger or a greater number of smaller "Air-Pump" Ventilators may be employed of equal total price of sizes and numbers as above given.

N.B.—In special cases, and where the conditions are unfavourable, larger Ventilators may have to be used than the sizes above recommended.

Plans and Estimates furnished free of charge.

Skilled Engineers and Experienced Workmen sent to any part of the United Kingdom.

Prices and Formulas.

For Prices and Formulas to be employed when specifying or ordering, see pages 89, 108, 109, 110, 120, 122, 124.

To Prevent Errors.

When specifying or ordering, the TITLES of the Ventilators should be given IN FULL as well as the Catalogue Numbers.

FOR ADDRESSES SEE PAGES 5 & 152.

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Robert Boyle, Inventor & Sanitarian.

(Founder of the Profession of Ventilation Engineering.)

By Lawrence Saunders.

New and Enlarged Edition, Price Six Shillings.

Opinions of the London Press.

"ROBERT BOYLE was a *savant*. There was no trace of selfishness in his actions, and in his inventions he was thinking more of the public good than of his own rewards. . . . It is full of interest as an account of a useful and benevolent life, and is also a very complete record of the progress of science in dealing with the difficult subject of ventilation."—*Architect*.

"A tribute of respect to one of the workers in the field of industry, whose efforts live in the form of benefits handed down to subsequent generations."—*Building News*.

"Deserves recommendation."—*Saturday Review*.

"ROBERT BOYLE was the author of many brilliant inventions, the best known of which is the method of ventilating public buildings which by general consent is the most effective that has yet been introduced. His career was an interesting one."—*Academy*.

"The subject of this sketch is worthy of remembrance."—*Notes and Queries*.

"This clever biographical sketch is well worth reading as the record of an active and well-spent life."—*Literary World*.

"The son of a Scotch surgeon, who made the lenses for his magic lantern missionary lectures, organised at Glasgow an industrial museum, invented an explosive shell, and who was led by his experience of the foul air of the slums to think out the well-known 'air-pump' ventilator."—*Graphic*.

"An enthusiastic tribute to the memory of an ingenious inventor and earnest man."—*Daily Chronicle*.

"A little book with much in it to suggest thoughts. It is a biographical sketch of the two BOYLES, father and son, who have made their names famous by their system of ventilation. More enthusiastic, simple-hearted men it would be hard to find. The history of their lives, their genius, and their inventions is most interesting."—*Life*.

"This little book gives the life work of two honest and persevering Scotchmen. Their inventive energies took a practical turn. The discovery of a new explosive, that of the still more important 'air-pump' ventilator, and other suggestions of a useful sort, together with a philanthropic kind-heartedness, render these worthy men deserving of their success."—*Bookseller*.

"A sketch—rather too brief—of the lives of ROBERT BOYLE, father and son, who have brought the question of ventilation and sanitation to a science by the discoveries of their inventive genius."—*Christian World*.

"A bright story of true Christian heroism. As we read through these pages of the almost insurmountable difficulties overcome by the BOYLES, father and son; of the good done; the sanitation achieved; the inventions perfected; we see men whose sole aim was to serve God, benefit mankind, and whose example should be held up to all our boys beginning life."—*Christian*.

"The record of an earnest, energetic, and untiring life; a life governed by high principle and devoted to noble ends. . . . His useful and laborious life needs no eulogy. Self-culture and help to others were his most marked traits. He was foremost in all social and sanitary improvements, and has left a legacy to the world of at least one invention which is of national worth—the 'air-pump' ventilator—that invention which has made the name of BOYLE world famous. . . . His name may therefore be enrolled, without hesitation, among the benefactors of the human family."—*Sanitary Engineering*.

"The record of the life of one of those strong, heroic, and enthusiastic men in whom the late Charles Kingsley would have delighted. It is rarely indeed that any man succeeds in crowding into his life so much of what is really good and useful as did the late ROBERT BOYLE."—*Civil Service Gazette*.

"Had Mr. BOYLE distinguished himself by nothing but the invention of the 'air-pump' ventilator, he would have well deserved to have a memorial of his career placed before the public. . . . The son inherits the ability and character of his father, and is highly esteemed for his scientific attainments, his literary power, and his influential position as the head of a large and important industry."—*British Mail*.

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Opinions of the Provincial Press.

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"ROBERT BOYLE bore a distinguished name in science and proved himself worthy of it. He is now best and most widely known through his 'air-pump' ventilator, which has been applied with signal success to many of our public buildings."—*Edinburgh Courier*.

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"An excellently written biography of the eminent inventor and philanthropist, ROBERT BOYLE. . . . The work is practically a biography of the late ROBERT BOYLE and of his son ROBERT, who is still living and carrying on his father's great work as a sanitary engineer. Both are characters such as Samuel Smiles might well apply his genius to describing."—*Hull Express*.

"A very readable sketch of the life of a remarkable man—a practical friend of the people, a worker rather than a talker, a man of broad intellect."—*Chester Chronicle*.

"A Scotchman of a peculiarly earnest mind, gifted at once with the inventive faculty and an intense desire to be useful and to confer benefits on his fellow-men."—*Halifax Courier*.

"A biographical sketch of the two BOYLES, father and son, from whom came the now celebrated 'BOYLE' ventilator."—*Plymouth Western Mercury*.

Robert Boyle & Son, Limited, 64, Holborn Viaduct, London, E.C.

MR. ROBERT BOYLE'S
"SANITARY CRUSADES,"

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A Sanitary Crusade through
The Continent of America.

A Sanitary Crusade through the
Far East (India, China, Corea, Japan)

A Sanitary Crusade through
South Africa.

A Sanitary Crusade through
Australasia, Polynesia, Java,
Borneo, Sumatra, Malay-
Peninsula, Siam, Barmah.

A Sanitary Crusade through
Europe.

A Sanitary Crusade through
North Africa (Morocco, Algeria,
Tunis, Tripoli, Egypt, The Soudan)

A Sanitary Crusade through
Iceland and The Faroes.

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Supplement.

Reproductions of Diagrams illustrating the action
Of
Natural & Mechanical Methods of Ventilation

Which
Appeared in a Series of Pamphlets containing Reprints of
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Ventilation

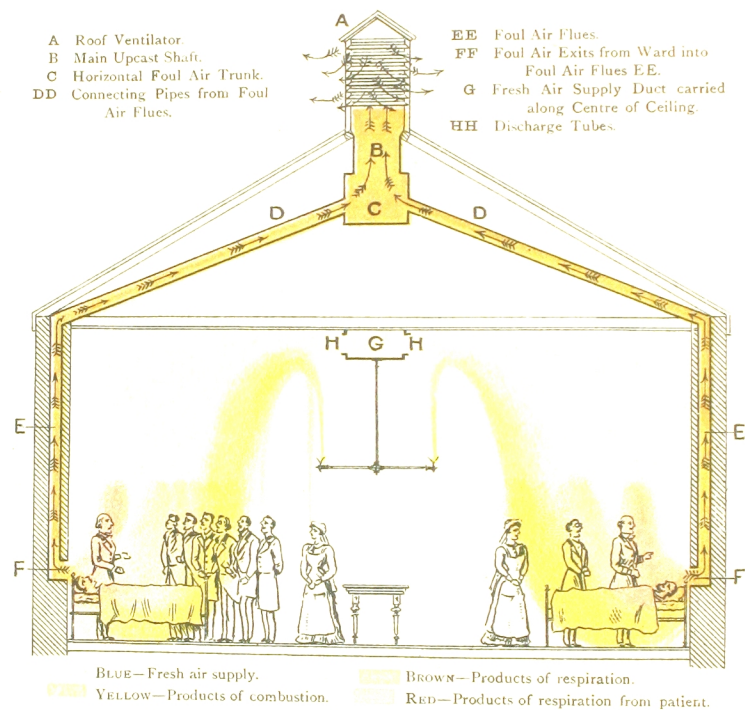
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Local Government Journal

Sept. 1st, Oct. 13th, Dec. 15th, 1894, and Feb. 16th, 1895.

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"MECHANICAL VENTILATION ON THE DOWNDRAUGHT PRINCIPLE,
BY IMPULSION, OR THE PLENUM SYSTEM, APPLIED
TO A HOSPITAL WARD."



"Downward ventilation returns the vitiated respired air to be rebreathed, also the poisonous products of combustion. Only an unendurable and highly dangerous downdraught could prevent the hot respired air ascending to a height sufficient to ensure its rebreathal. With this system the patients in a hospital inhale foul air only. If the foul air exits are placed either above, below, or at the side of the bed, the results are the same, also when the fresh air is forced in at the upper parts of the side or end walls, or is projected up on to the ceiling."

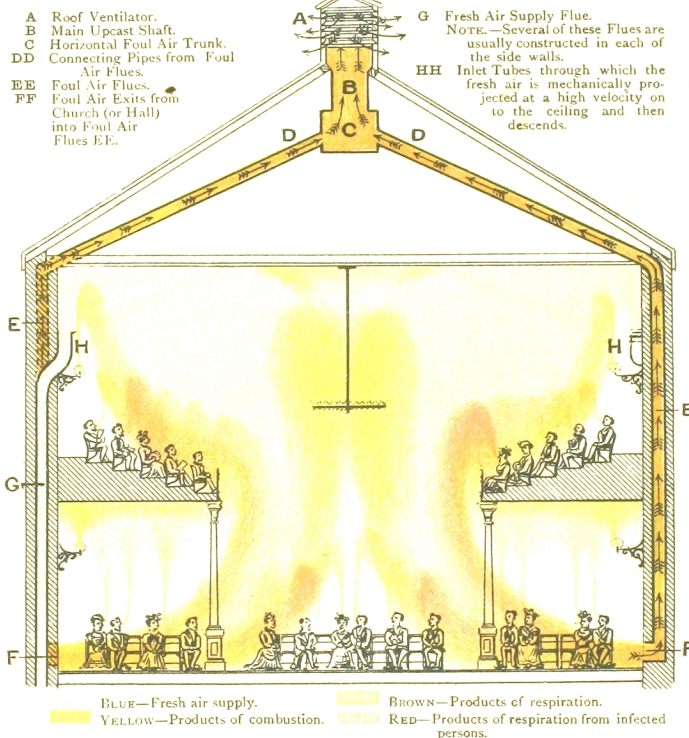
A SOURCE OF INFECTION.

"The breath from a fever patient being of a higher temperature than that of a person in ordinary health, ascends to a greater height, before being pressed down by the descending current, and is inhaled by those who may be close to the bedside, owing to the spreading and consequent diffusion that takes place. Where the current is upwards, as in natural ventilation, the breath from the patient ascends in an unbroken column, and is immediately drawn away without coming into contact with anyone.

"With a downdraught system the patient must inevitably rebreathe a considerable portion of not only his own exhausted air, but also a certain proportion of that of the patients on each side of him, and of persons standing about his bed.

"The watery vapour of his breath, in which the disease germs are suspended, is likewise precipitated on to the bedclothing by the downward current, and there accumulating, proves not only a means of considerably retarding his recovery, if it is not indeed the actual cause of his death, but is a dangerous source of infection to others."—*Local Government Journal*.

**"MECHANICAL VENTILATION ON THE DOWNDRAUGHT PRINCIPLE,
BY IMPULSION, OR THE PLENUM SYSTEM, APPLIED
TO A HALL OR CHURCH."**



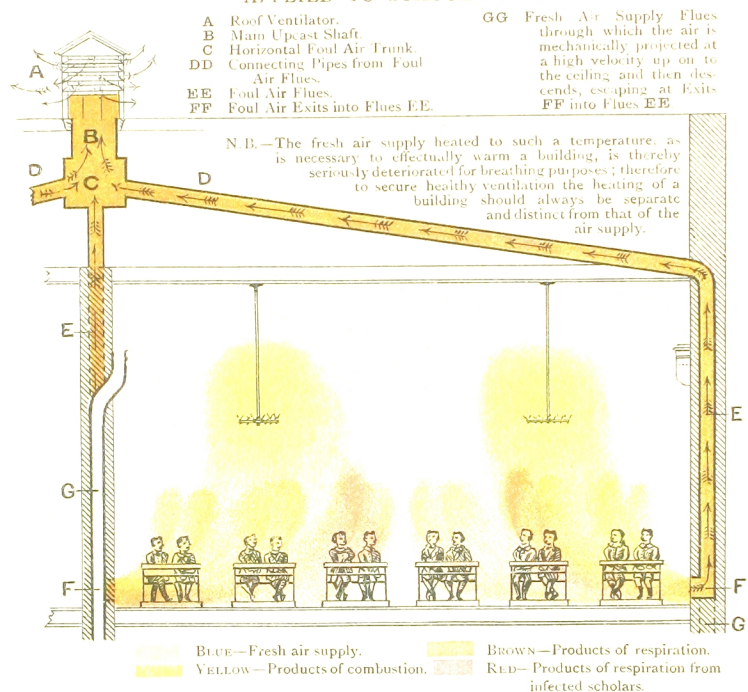
"In halls arranged with galleries, the difficulty of so arranging downward currents that, on the one hand, the air rendered impure in the galleries shall not contaminate that which is descending to supply the main floor below, and, on the other hand, the supply for the floor shall not be drawn aside to the galleries, is so great that it is almost an impossibility to effect it. —Extract from Government Report to Congress on the failure of mechanical ventilation at the Capitol, Washington, U.S.A.
 "The air is delivered by fan propulsion and is taken out at the floor, giving a downward system of ventilation. The air vitiated by respiration is brought back to be reinhaled. . . .
 M. Trélat emphatically condemns downward ventilation."—Extract from Official Report on the failure of mechanical ventilation at the Chamber of Deputies, Paris."

COMPARATIVE ADVANTAGES OF UPWARD AND DOWNWARD METHODS OF VENTILATION.

"In a Government report on ventilation laid before the United States Congress, Clause 3 of the report states:—'In large rooms an enormous quantity of air must be introduced in the downward method if the occupants are to breathe pure, fresh air, or about *three times the amount* which is found to give satisfactory results with the upward method.

"'For these and other reasons the Board are of opinion that the upward method should be preferred.'"—*Local Government Journal*.

"MECHANICAL VENTILATION ON THE DOWNDRAUGHT SYSTEM,
BY IMPULSION, OR THE PLENUM PRINCIPLE,
APPLIED TO SCHOOLROOMS.

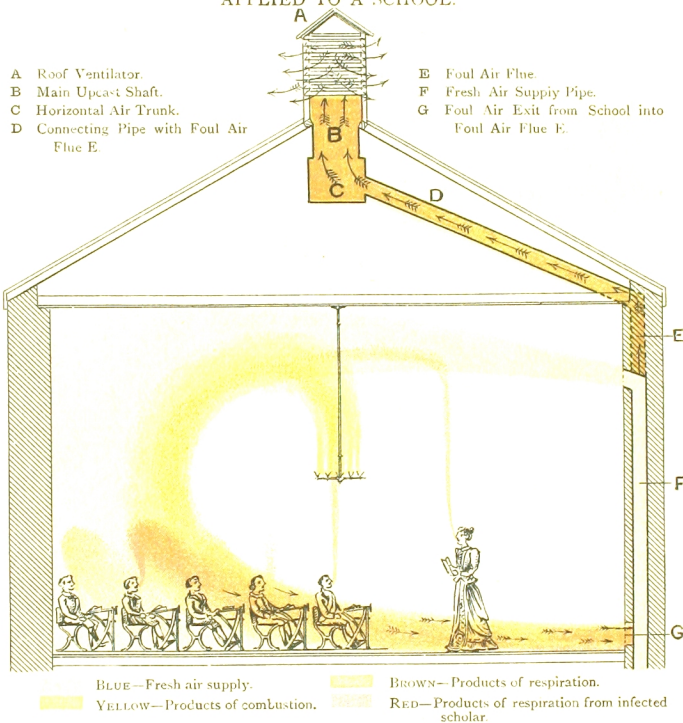


"With all downdraught systems diluted foul air only is breathed, never fresh, pure air, as the respired and exhausted air first, owing to its greater levity, ascends, and is returned by the downward current to the breathing level mixed with the products of combustion, and is there reinhaled. Only a very strong, and what would be an unendurable downdraught, could prevent the highly rarefied respired air from rising to a height sufficient to ensure its rebreathal. . . . It is universally condemned by scientific authorities as most pernicious, contrary to the laws of Nature, and—from causes which are well known—fatal to health, insidiously sowing the seeds of disease."—*Building News*."

DOWNDRAUGHT VENTILATION.

"This is one of the very earliest forms of mechanical ventilation, devised at a time when the law of diffusion was but imperfectly understood in connection with its relation to ventilation, and when it was the popular belief that carbonic acid gas and other impurities evolved in an occupied building fell to the lower level, and there accumulated in stratas—hence the supposed necessity for expelling the foul air at the floor level, a method now obsolete and out of date."—*Local Government Journal*.

"MECHANICAL VENTILATION ON THE LATERAL AND DOWNWARD
PRINCIPLE, BY IMPULSION, OR THE PLENUM SYSTEM,
APPLIED TO A SCHOOL."



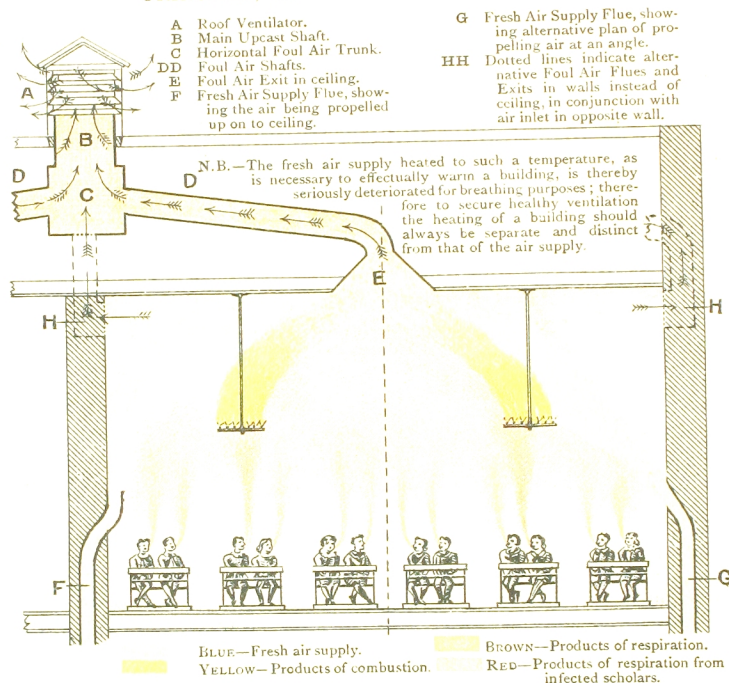
"It is well known to sanitarians that such a mode of changing the air (downward ventilation) is inimical to health, being not only a direct cause, but a fruitful means of disseminating disease, as evidenced by the report issued by the Local Government Board, one town, where the schools are mechanically ventilated on the downdraught principle, being specially mentioned as the "chief focus" of the disease (influenza) in Scotland."—*Local Government Journal on Report to Parliament by the Local Government Board.*"

HOW INFECTION IS SPREAD.

"The report on the influenza epidemic presented to Parliament by the Local Government Board indicates the extreme importance of proper ventilation—especially in schools—which is pronounced to be the only real safeguard against that disease.

"The statistics given point to one town, where the schools are mechanically ventilated on the downdraught principle, as being the 'chief focus' of the disease in Scotland. So far as the children in the schools are concerned this is easily accounted for, as the warm, infected air expelled from the lungs is returned by the descending current, and is not only reinhaled, but is also breathed by the other scholars. This is how infection is spread."—*Local Government Journal.*

"MECHANICAL VENTILATION BY IMPULSION, OR THE PLENUM PRINCIPLE, APPLIED TO SCHOOLROOMS."



"Mechanical ventilation by impulsion forces air into a building under pressure and at a high velocity—destructive of diffusion—causing disagreeable and dangerous draughts in the vicinity, and in the line of the inlets and outlets, the other parts of the building being left wholly unventilated, as the incoming columns of air usually travel, or are propelled, in a direct line to the nearest outlet, and there make their escape. Engine-driving columns of air through a building is not ventilating it. . . . It is wholly misleading to take the registered volumes of air forced into or out of a building at certain points as in any way indicating how often in a given time the whole of the air is changed."—*Building News*.

NOTE.—When a volume of air is forced in under pressure a certain portion is deflected and descends, as with the downward system, returning the respired air to be reinhaled, also the products of combustion."

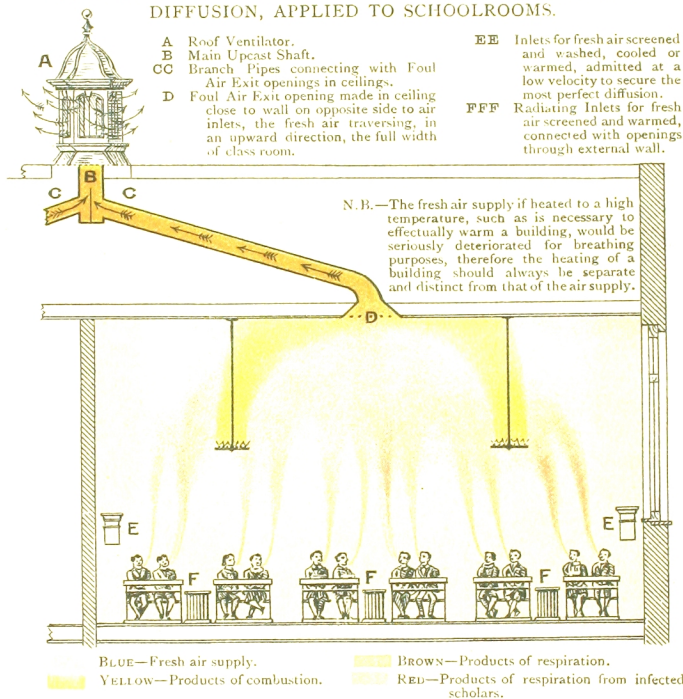
AIR ANALYSES AND DEFECTIVE VENTILATION.

"It is now admitted that air analyses cannot always be accepted as correctly demonstrating the general purity of the air or efficiency of the ventilation, as in buildings where the ventilation has been condemned as dangerously defective the air analyses were seemingly all that could be desired, whilst the registered volumes of air forced in were enormous.

"Wonderful results may be shown in the way of tables of cubic feet of air propelled into a building, but they are illusory as in any way indicating the efficiency of the ventilation.

"The architect to the Local Government Board reports that 'mechanical ventilating arrangements are generally utter failures.'"—*Local Government Journal*.

**"NATURAL SYSTEM OF VENTILATION BY EXTRACTION AND
DIFFUSION, APPLIED TO SCHOOLROOMS.**



"Science proves that there is not a moment of time but when there is a movement of the air, and that this movement properly utilised is sufficient at all times to change the air in a building and secure ventilation."

"Ventilation can only be successfully accomplished at all times when it is effected without assistance from mechanical or artificial contrivances. However perfect these may appear, they can never achieve results superior to those ensured by judicious and intelligent adaptation of natural means; and they necessarily suffer from the very serious disadvantage that they are liable to interruption without warning, and with possibly disastrous consequences."—Professor WADE, Lecturer on Hygiene, Oxford University Extension.

NATURAL v. MECHANICAL EXTRACTION.

"In a paper on 'Ventilation' read before the Society of Arts, London, February 1st, 1893, the respective values of natural and mechanical methods of ventilation were explained by the lecturer, who said:—

"After several tests in schools ventilated on each system, it was clearly demonstrated that in none of the schools examined and ventilated mechanically by extraction—even in a new school opened for a week or two—was the air found to be more pure than in those examined and ventilated naturally without any mechanism.

"Draughts existed in the upper levels of every room ventilated mechanically by extraction, while the halls of such buildings were generally full of draughts."

"According to the analyses, the number of bacteria found in the air of the schools ventilated naturally were about 25 per cent. less than in the air of the schools mechanically ventilated."—*Local Government Journal*.

Ventilation.

Extracts from a paper on "Hospital Construction," read before the Liverpool Architectural Society, on November 7th, 1898, by Dr. JOHN W. HAYWARD.

"Incessant movement of the air is a law of Nature; we have only to allow the air in our cities and dwellings to take share in this constant change, and ventilation will go on uninterruptedly without our care."—PARKES.

"For hospital wards open fires are risky, costly, and troublesome; they greatly embarrass all plans of ventilation, and are in many other ways objectionable. They are of but little use as means of ventilation; they certainly abstract air, but they take it principally from near the floor, whereas the foul air accumulates near the ceiling, being heated and so made light by the same means that foul it. Hospitals warmed only by open fires are sure to be very imperfectly warmed; and if at the same time they are attempted to be ventilated only by open windows they are most certainly also very imperfectly ventilated. It is much to be regretted that some hospitals are professed to be ventilated and warmed by simply open windows and open fires, even throughout the winter in this climate. . . .

"In a Blue Book, issued in 1898, 'On the Ventilation and Warming of Board Schools,' on p. 23 occurs this statement in reference to ventilation by open windows: 'In those cases in which the ventilation was effective the temperature of the dormitory would follow closely that of the outside air, and would not exceed that of the outside air by more than about $2\frac{1}{2}$ deg.' . . .

"In spring and autumn the weather is then generally too cold to have the windows always open and yet not cold enough to have the fires continually burning, so that the abstraction cannot then be accomplished efficiently by either windows or fires; it must consequently be done by outlets specially provided for the purpose. 'The foul air,' says the writer in the Encyclopedia, 'should be taken out at the highest part of the ward.' These outlets should then be in the wards, in or near their ceilings. . . .

"'While the air is in the lungs,' say the Government Commissioners, 'it acquires so much heat that it becomes specifically lighter than the surrounding air, and rises above our heads; . . . the heated air which passes upwards should pass away. . . . For the ventilation of rooms exits should be provided for the spent air near the ceiling.' . . .

"To the plan of abstracting the foul air near the floor, there are at least four grave objections: (1) It is opposed to Nature's law of atmospheric pressure, and therefore requires the use of special abstracting power by means of furnaces for its accomplishment; (2) By drawing down the foul air it causes it to be breathed over again, which recently breathed air ought never to be; (3) The fresh air supplied is apt to be forced in overheated, in fact burnt, and so made unhealthy; (4) The long tortuous abstraction flues cannot be kept clean, and will, therefore, become lurking places for dust and germs. The plan is quite unsuitable for hospitals, and should certainly never be used where there is likely to be infection. . . .

"'The method of low ventilation,' say the Government Commissioners, 'should be avoided on various grounds. . . . The heated air which passes upwards should pass away.' (Blue Book, p. 4—bottom—and 30.) . . .

"The outside air presses in through the inlets and the inside air presses out through the outlets at a speed determined by the difference in weight; that is, in winter, a difference between air averaging about 35 deg. F. or lower and about 65 deg. F. or higher. Now, according to the laws of atmospheric pressure, this difference produces a speed of at least 8 ft. per second in ordinary flues or chimneys. (Blue Book, p. 6.) . . .

"If, therefore, the inlets and outlets be properly proportioned and open, the ordinary atmospheric pressure will carry on the ventilation quite efficiently, and the whole hospital will be kept fresh and comfortable by the natural forces alone. There is no fear that the speed will not be enough to keep up efficient ventilation, it is more likely to be too great; but there need be no fear of its being too great, because it is completely under control, and can be regulated to any rate desired, by the valves at the ward inlets and outlets. . . .

"The plan here sketched out is, in its main features, natural or 'spontaneous' ventilation. Natural ventilation is certainly much to be preferred to any and every artificial system, whether on the plenum or vacuum principle, and it is, of course, much less complicated. It is, indeed, comparative simplicity itself—merely arranging openings and warming the air, and, as shown above, it acts more than efficiently. It also involves very little original outlay, and comparatively no permanent cost for maintenance. Whereas all artificial systems involve costly original plant of machinery, as well as heavy permanent expense for maintenance in engines, engineers, fuel, &c., and with all they cannot be made as efficient or nearly so pleasant and healthy in operation. . . .

"I am, of course, well aware that some medical practitioners do recommend hospitals to be ventilated only by open windows on both sides of large wards, even in winter in this climate, and maintain that there is neither risk nor discomfort in doing so. They do not themselves, however, submit to such ventilation; that is, they do not themselves sit in their study, or have their families to sit in the morning room or sleep in bedrooms with windows to the east open all the winter through! And it is only bounce for matrons and nurses to acquiesce in such an arrangement and uphold it; they are themselves not confined to beds underneath open windows, but are moving about in and out of the wards. Nor do they submit to it in their own rooms during cold easterly windy days and nights. The helpless patients scarcely dare complain or even admit that they feel a draught if the nurse says they do not."

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[ENTERED AT STATIONERS' HALL.]





Handwritten musical notation on a single staff, consisting of a series of rhythmic notes and rests, likely a single melodic line. The notation is written in a historical style, possibly from a 16th or 17th-century manuscript. The notes are connected by horizontal lines, and there are various rests and accidentals visible. The paper is aged and yellowed, with some staining and wear along the edges.

